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# POCS REFERENCE PAPER NO. I

## Seabirds And Marine Mammals Of The Southern California Bight

Bureau of Land Management
Pacific Outer Continental Shelf Office
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# PREFACE TO POCS REFERENCE PAPER NO. I

Marine mammals and seabirds are among the most conspicuous environmental elements on the Outer Continental Shelf of the Southern California Bight.

Despite the proximity to major population centers, no broad, systematic surveys of the marine mammal and seabird populations within the Bight had been completed. Therefore, in an attempt to fill this data gap, and to provide a better basis upon which possible impacts on marine mammal and seabirds due to OCS oil and gas development could be judged, the Bureau of Land Management entered into a contract with the Regents of the University of California; University of California, Santa Cruz.

This POCS Reference Paper No. I was compiled and edited by Maeton R. Freel, a Wildlife Biologist, and Michael E. Aceituno, Fishery Biologist, of the Pacific Outer Continental Shelf Office, Los Angeles, California, and is a summarization of the first-year report of the Marine Mammal and Seabird Survey of the Southern California Bight, conducted by Norris, et al., under BLM Contract No. 08550-CT5-28.

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Table of Contents


| | | Page |
|---|---|---|
| I. | INTRODUCTION | 1 |
| II. | MARINE BIRDS OF THE SOUTHERN CALIFORNIA BIGHT | 2 |
| | A. Introduction | 2 |
| | B. Faunal Elements | 2 |
| | C. Nesting Colonies | 6 |
| | D. Distribution, Numbers, and Seasonal Dynamics | 8 |
| III. | MARINE MAMMALS OF THE SOUTHERN CALIFORNIA BIGHT | 16 |
| | A. Introduction | 16 |
| | B. Pinnipeds | 16 |
| | 1. California Sea Lion (Zalophus californianus) | 16 |
| | 2. Northern Elephant Seal (Mirounga angustrirostris) | 36 |
| | 3. Northern Fur Seal (Callorhinus ursinus) | 52 |
| | 4. Harbor Seal (Phoca vituliwa) | 61 |
| | 5. Steller Sea Lion (Eumetopias jubata) | 76 |
| | 6. Guadalupe Fur Seal (Arctocephalus townsendi) | 81 |
| | C. Cetaceans | 82 |
| | 1. Pacific Right Whale (Balaena glacialis) | 84 |
| | 2. Mink Whale (Balaenoptera acutorostrata) | 88 |
| | 3. Sei Whale (Balaenoptera borealis) | 89 |
| | 4. Finback or Fin Whale (Balaenoptera physalus) | 90 |
| | 5. California Gray Whale (Eschrichtius gibbosus) | 91 |
| | 6. False Killer Whale (Pseudorca crassidens) | 92 |
| | 7. Killer Whale (Orcinis orca) | 93 |
| | 8. Pacific Pilot Whale (Globicephala macrorhyncha) | 94 |
| | 9. Hubb's Beaked Whale (Mesoplodon carlhubbsi) | 94 |
| | 10. Cuvier's Beaked Whale (Ziphius cavirostris) | 95 |
| | 11. Pygmy Sperm Whale (Kogia breviceps) | 96 |
| | 12. Sperm Whale (Physeter catadon) | 96 |
| | 13. Common Dolphin (Delphinus delphis) | 97 |
| | 14. White-Sided Dolphin (Lagenorhynchus obliquidens) | 98 |
| | 15. Northern Right Whale (Lissodelphis borealis) | 99 |
| | 16. Harbor Porpoise (Phocoena phocoena) | 100 |
| | 17. Dall Porpoise (Phocoenoides dalli) | 101 |
| | 18. Long-Beaked Dolphin (Stenella caeruleoalba) | 102 |
| | 19. Pacific Spotted Dolphin (Stenella graffmani) | 102 |
| | C. Carnivores | 103 |
| | 1. California Sea Otter (Enhydra lutris) | 103 |

# I. INTRODUCTION

The material included within this document is meant to supplement the Environmental Statement prepared by the BLM Pacific OCS Office for the proposed 1979 Outer Continental Shelf Oil and Gas Lease Sale No. 48 Offshore the Southern California Bight.

While a summary of much of this information is included within the body of the Environmental Statement, it may be desirable to have more detailed information available for review. Therefore, this paper presents additional information concerning marine bird and marine mammal species which occur within the area of the Southern California Bight. Visuals referred to in this paper are those accompanying the Environmental Statement for OCS Sale No. 48.

# II. MARINE BIRDS OF THE SOUTHERN CALIFORNIA BIGHT

## A. Introduction

This section presents information on faunal elements, nesting colonies and factors affecting the fluctuations, distribution, numbers and seasonal dynamics of the marine birds of Southern California.

The marine avifauna of the Southern California Bight is both large and complex; the 64 species for which baseline data were collected in 1975-76 (Norris, et. al., 1926) comprise six major faunal elements, each of which is characterized by unique patterns of movement and seasonal abundance. Some of these faunal groups have been described or categorized several times in the past (e.g., Howell 1917, Scott 1974, and Small 1974), but none of these authors have had the benefit of the broad and systematically collected data presented here. Accordingly, a synopsis of the major divisions of the Southern California marine avifuana is presented emphasizing species found to be conspicuous in 1975-76. This classification will then be used as a basis for discussion of the significant eco-geographic features of the data.

## B. Faunal Elements

1. Nesting Species: A total of nine seabird species nesting on the California Channel Islands were recorded in 1975-76. They were: Ashy Storm-Petrel; Brown Pelican; Double-crested, Brandt's and Pelagic Cormorants; Western Gull; Pigeon Guillemot; Xantus' Murrelet; and Cassin's Auklet. Three other species, Least, Caspian and Elegant Terns, nest on mainland beaches, though the latter has only one U.S. colony in south San Diego Bay. Three other species have nested in the area in the past: Common Murre and Tufted Puffin on the Channel Islands, and Royal Tern, once in San Diego. These latter three species are not discussed further here.

Of the regularly nesting species, seven (pelicans, three cormorants, gulls, murrelet and auklet) are year-round residents in the Southern California Bight. The Ashy Storm-Petrel may also be resident all year. Despite the term "resident", there is considerable seasonable movement of the populations of most of these species. The Brown Pelican reaches the northern limits of its present breeding range on Anacapa Island and the number of nesting pelicans present in the Bight during the breeding season (March-June) is actually quite small compared to the large influx of pelicans from Mexican breeding colonies after the breeding season (see Anderson and Anderson, 1976). Western Gulls, particularly immatures, exhibit some tendency to move to mainland beaches and garbage dumps after the breeding season and their numbers are supplemented by small numbers of gulls from north of the area in winter.

It is not clear at present what happens to the bulk of the Channel Islands' Xantus' Murrelet populations after the breeding season. They disperse from their breeding islands in June and July and become considerably less abundant until January when the first murrelets return to their breeding grounds. Some murrelets disperse northward in late summer as evidenced by occasional murrelet observations in Monterey Bay and the San Francisco area between August and March (McCaskie and de Benedictus 1966).

The Cassin's Auklet population is relatively stationary, although there is a distinct shift away from the waters around their breeding colonies in fall and winter and a slight southward shift as well. Whether auklets from farther north reach Southern California in winter is not known. Banding data from the Farallons indicate that the large population there winters primarily in Monterey Bay.

The three cormorant species are probably the most sedentary of the breeding seabirds in the Bight. The year-round population on the islands as a whole appears to remain rather constant, though there is some inter-island shifting of numbers, perhaps in response to continually shifting food supplies.

The Ashy Storm-Petrel is difficult to distinguish from other species of storm-petrels, thus its at-sea distribution and seasonality is not well known. Data from 1975-76 and unpublished data of Jones, McCaskie and others from former years, suggest that they are present in the area in small numbers at least from May to January, and perhaps all year.

The other four species -- Pigeon Guillemot and the three tern species -- are clearly summer residents. Pigeon Guillemots are absent from Southern California waters from September until February, and it is not presently known where the Channel Islands' populations spend the winter. They do not go south, nor is there any indication of a northward migration. They might move out to sea, as suggested by Grinnell and Miller (1944), where few observation vessels venture and thus remain undetected during this season.

Least Terns begin to migrate to South America in September and return again in April. Elegant Terns move northward into California from Mexico in late summer, often in large numbers, then depart for South America in October and November. The 100 or so pairs that nest in San Diego return from South America to breed in March (McCaskie, personal communication). Though a few caspian Terns regularly winter as far north as San Diego and occassionally farther north, the bulk of their population migrates to South America in October and November, returning again in late March.

Although estimates of total numbers of nesting seabirds in the Southern California Bight are not available, it is clear that Brandt's Cormorant, Western Gull and Cassin's Auklet are the most numerous. Based on 1975 breeding census data, at least 3,700 Brandt's Cormorants (1,850 pairs) breed in the area and another 7,500 or so non-breeding individuals are present at any given time. The number of Western Gulls breeding in the Bight appears to be at least 6,000 and perhaps as much as 10,000 with inclusion of the smaller islands and islets, plus an unknown number of scattered pairs on the larger islands. There are approximately 20,000 Cassin's Auklets breeding on Prince Island (off San Miguel Island), alone, and an unknown, but undoubtedly smaller, number on the other islands plus an unknown number of nonbreeding individuals.

Other species are present in smaller numbers, at least during the breeding season. The number of Xantus' Murrelets breeding in Southern California is not at all clear, though the approximately 2,000 (1,000 pairs) that nest on Santa Barbara Island may represent the vast majority of the breeding population in the Bight. The total number of Pigeon Guillemots in the area is around 1,000 on San Miguel and Santa Barbara Islands, plus an unknown number (perhaps another 1,000) present at Santa Rosa and Santa Cruz Islands. In 1975, only 600 Brown Pelicans nested or attempted to nest in the area, but the total number present was many times higher by September when breeding bird numbers were augmented with birds from Mexican breeding colonies.

Numbers of Ashy Storm-Petrels, Double-crested and Pelagic Cormorants in the Bight were considerably less, and probably totaled no more than 2,000 individuals, combined, in 1975 (excluding the immature Double-crested Cormorants found in coastal lagoons on the mainland).

2. Year-round Visitors: This group includes those species that do not breed in Southern California, but which can be expected at any time of year. Those species found in winter which are represented by a few over-summering individuals (e.g., loons, grebes, scoters) are not included here.

Two species of gulls and one tern which breed north of the area may be considered year-round visitors in Southern California. The two gulls (California and Ring-billed) and one tern (Forster's) however, are much more abundant in the area from October to April. Two species, Black Storm-

Petrel and Royal Tern, breed just to the south, the former on Islas Los Coronados in extreme northern Baja California, and the latter on mainland beaches of central and southern Baja. Both these species are present year-round south of latitude 33°N, but the storm-petrel is apparently irregular, or scarce, in winter north of there and the tern is absent in spring north of San Diego. The Black-footed Albatross breeds in the central Pacific and a few individuals can be expected far offshore at any season.

3. Summer Visitors: Six species can be listed in this category, three of which nest to the south in Baja California, two more of which nest in the southern hemisphere and spend their "winter" in our area, and a sixth species which nests both north and south of, but not in, the Bight. The Least Storm-Petrel, Red-billed Tropicbird and Craveri's Murrelet all nest in Baja California and quite regularly wander north into Southern California waters in summer and early fall. Leach's Storm-Petrel nests in Baja, as well, but also nests from Northern California to Alaska. It is present in Southern California from April until October and is often found farther offshore than the other species of storm-petrels.

Two species of shearwater (Pink-footed and Sooty) which nest in the southern hemisphere and spend the austral winter in the northern hemisphere are found in Southern California from April through December, with a few non-breeders remaining through the winter. At times Sooty Shearwaters are the most abundant bird in the Bight, with numbers reaching into the millions.

4. Winter Visitors: This category includes nearly half of all the regularly occurring seabirds in Southern California and generally represents the greatest biomass from October through April. A winter visitor is defined as any species which is present during the winter months; however, the vast majority of its population departs during the species' breeding season. The category includes species such as Heermann's Gull which is present from June through March, and Northern Fulmar which, when present at all, is found from November until June. Other species included in this group are: Common Loon (late October-May); Arctic Loon (late October-early June); Red-throated Loon (mid-October-late April); Eared Grebe (September-early May); Western Grebe (late September-early June); Short-tailed Shearwater (November-February {rare and irregular in occurrence}); Manx Shearwater (September-February); Fork-tailed Storm-Petrel (a rare and irregular visitor exhibiting no apparent seasonality); White-winged Scoter (late September-late April); Surf Scoter (early October-early June); Red-breasted Merganser (late September-early May); Red Phalarope (early August-late May); Pomarine Jaeger (August-May); Glaucous-winged Gull (late October-mid-May); Herring Gull (November-April); Thayer's Gull (November-April); Mew Gull (November-April); Bonaparte's Gull (late October-late May); Black-legged Kittiwake (November-May {highly irregular in occurrence from year to year; after winters of big influx, many birds may remain through the summer}); Common Murre (November-April); Rhinoceros Auklet (December-April).

5. Transients: Birds in this group are those that pass through Southern California waters while migrating between their wintering and breeding grounds. The New Zealand Shearwater is generally a rare fall transient (September-November), but a few records of strays exist for other seasons. Though Brant are winter visitors in Southern California, they are strictly transients offshore, wintering in lagoons and estuaries away from the exposed beaches. Migrating groups can be seen traveling south in October and November and returning to their breeding grounds in the Arctic in March and April. Parasitic Jaegers are regular spring and fall transients, primarily to waters near mainland beaches. Though this species can be seen at almost any time of year, it is relatively scarce in mid-winter and in June and July. Long-tailed Jaegers migrate far offshore in fall and can occasionally be seen in the Bight between late August and early November. South Polar Skuas, the only species in this group that breeds in the southern hemisphere, can be seen between June and October as it passes southward along our coast during what is thought to be a Pan-Pacific clockwise migration (see Devillers as cited in Jehl,, 1973). Sabine's Gulls are present in spring from mid-April until mid-June while on their way to Alaskan breeding grounds and again between mid-August and mid-October on their way south to South America where they spend the winter. A few birds can be seen through the summer, but none are present in winter. Common Terns are present (generally near shore) from April to June and August to November, and Arctic Terns are present offshore from mid-April to late May in small numbers and from mid-July to early October in larger numbers. Horned Puffins are present in modest numbers between early May and early June. One theory (Hoffman et al., 1975) suggests they winter in the mid-Pacific Ocean at latitudes as far south as Southern California, a few drifting eastward with the currents, then migrating northward in spring along the California coast to Alaskan breeding grounds. Almost no seabird work has been conducted far at sea in mid-winter; thus, it is not known what species are actually present there during this season.

6. Strays: Birds in this category occur in such small numbers that they are not considered part of Southern California's expected avifauna. Four such species were found in 1975-76. Three were strays from farther north and one was a stray from the central Pacific. The Red-necked Grebe and Ancient Murrelet normally do not occur south of central California, though one of the former and two of the latter have been observed all north of 34°N latitude. One of the murrelets was oil-soaked and probably drifted south after becoming incapacitated. One Laysan Albatross was encountered in January far offshore at Cortes Bank. This species is only rarely seen within 180 km (112 miles) of the Southern California coast.

A probable sighting of a Cape Petrel on August 30, 1975, is in a category all its own. Although there are a dozen or more reports of this species from the northern hemisphere (Atlantic and Pacific Oceans), only one or two of these have been properly documented (Bourne, 1967).

B. Nesting Colonies

In light of present records and historical data it is clear that the populations of several species of seabirds that have nested in the Channel Islands have declined. Of the eleven species that were breeding in the Channel Islands 75 years ago, two no longer nest there (Tufted Puffin and Common Murre) and five species (Brown Pelican, Double-crested Cormorant, Brandt's Cormorant, Pelagic Cormorant and Cassin's Auklet) have diminished in range or population size or both. The numbers of Western Gulls, Pigeon Guillemots and Xantus' Murrelets have apparently remained similar to what they were previously, although there may have been some distributional changes. The Ashy Storm-Petrel may have decreased in numbers, but this is a nocturnal, burrow-nesting species which is often difficult to detect. Its present-day population levels and extent of range on the Channel Islands are poorly understood.

A number of different factors have contributed to the decline of various seabird populations but virtually none of the causes are adequately documented, with the exception of the correlation between chlorinated hydrocarbon residue levels, eggshell thinning and reproductive failure. The losses of species at the fringe of their range (Tufted Puffins and Common Murre) and the loss of small populations of species from accessible islands (cormorants on Santa Catalina Islands were undoubtedly hastened by the efforts of bird and egg collectors who particularly sought specimens of rare species). However, collecting does not seem adequate to explain the complete disappearance of colonies which, upon their last visitation, were "large", and it does not explain the decrease in the Brown Pelican, the three cormorants or the Cassin's Auklet.

Chlorinated hydrocarbons have been identified by Anderson and Anderson (1976) and others as a major factor in reproductive failure of the Brown Pelican and the associated decrease in the numbers of the nesting pairs of this species in Southern California. However, in the last few years it appears that the reproductive success of pelicans has improved and that a gradual increase in their populations may occur, (Anderson, et al., in press; Anderson and Anderson, 1976).

Anderson, et al., (1969) and Gress, et al., (1973) have documented the decline of Double-crested Coromorants in the Channel Islands. They have linked this decline with decreases in eggshell thickness which, in turn, have been correlated with chlorinated hydrocarbon levels in adult tissues. Eggshell thinning was documented in Brandt's Cormorants on San Nicolas Islands in 1973 which led to reproductive failure. While detailed information on eggshell thinning and reproductive failure in Brandt's Cormorants and Pelagic Cormorants is not avilable at present, it is possible that pollution by chlorinated hydrocarbons has contributed to the decline of their populations.

Disturbance is another factor to which pelicans and cormorants are very sensitive, and it is likely that disturbance has contributed to the decline of these species. Both pelicans and cormorants are easily frightened from their nests, and gulls are quick to take the exposed eggs. Because predation related to disturbance can result in complete reproductive failure of a cormorant or pelican colony, it is critical to minimize disturbance of these birds while they have eggs or small young. It is for this purpose that West Anacapa Islands and Scorpion Rock have been closed to all visitation during the pelican nesting season.

Predators such as cats and rats, when introduced to islands, may exterminate burrow-nesting forms. It is likely that cats caused the elimination of Cassin's Auklets from Santa Barbara Islands and rats have probably contributed significantly to the decline of Xantus Murrelets on Anacapa Island. However, it is unclear why cats did not destroy the Xantus' Murrelet population on Santa Barbara Island.

The possibility that the long term fluctuations in food resources may have resulted in the decrease of certain seabird populations has been put forward by Ainley and Lewis (1974) to account for differences in the rate of increase of various species of seabirds on the Farallon Islands. They believe that the demise of the Pacific sardine (Sardinops caerulea) may have resulted in the decrease of both the Tufted Puffin and Double-crested Cormorant. It is possible that the Double-crested Cormorants in the Channel Islands have been affected by the loss of sardines, but in the Southern California Bight the decrease in cormorant populations seems to be a more recent phenomenon. The Tufted Puffins apparently disappeared from the Channel Islands long before loss of sardines stocks, and it does not appear to be a good explanation for their decline.

Ainley and Lewis (1974) also believe that periodic fluctuations in the cold, nutrient-rich California Current and unusually long incursions of the warm, nutrient-depleted countercurrent may explain changes in local oceanic productivity which would affect seabird numbers and breeding success in central California. It seems unlikely that short-term fluctuations of the currents could account for long-term declines in seabird populations of the Channel Islands, although the fluctuations might be sufficient to push a small, marginal population to local extinction.

Short-term fluctuations in food resources may, however, be an important factor in the short-term population fluctuations and colony shifts observed in Brown Pelicans. Observations that indicate an island supporting a large colony one year may not be used the following year. Also, pelicans beginning their breeding activities at a given site in February one year may not begin breeding there until May the next year. The same seasonal differences have also been observed at different sites

in the same year. Such temporal and spatial shifting of breeding activity does not, of course, lessen the significance of the recent extended population decrease.

Oil pollution has not thus far been identified as a cause of the decline of a population of seabirds nesting in the Channel Islands. However, on the Fallallon Islands, Ainley and Lewis (1974) have linked sharp declines in Tufted Puffin and Pigeon Guillemot numbers to oil pollution.

The factors discussed above may singly or combined account for the decreases in populations of cormorants, pelicans, auklets and some murrelet populations. At present, insufficient knowledge of Ashy Storm-Petrel distribution and numbers in Southern California prevents any speculation on their current status relative to past numbers.

In summary, while the present day populations of seabirds nesting on the Channel Islands are, in many cases, only a fraction the size of former populations, several islands support important marine bird populations. Anacapa Island and Scorpion Rock are crucial because they support the only nesting colonies of the endangered Brown Pelican in California. San Miguel Island and its surrounding islands support large populations of cormorants, gulls and alcids which will be exceedingly vulnerable to either spilled oil or such secondary effects of oil resource development as disturbance by aircraft over-flights, recreational visitation or infestation by rats or cats should shore facilities be developed. Xantus' Murrelets, which occur in large numbers on and around the Santa Barbara Islands would be exceedingly vulnerable to oil spilled on the water's surface in the vicinity of this island.

In contrast, other islands support relatively few nesting seabirds. San Clemente and Santa Catalina Islands have virtually no nesting seabirds. On the main island of Santa Cruz and on Santa Rosa Islands nesting seabirds are almost exclusively restricted to the northern sides, where Pigeon Guillemots and Brandt's Cormorants nest in modest numbers. An exception is the small dense colony of four species on Gull Island off the southwest corner of Santa Cruz Island. Finally, on San Nicolas Island, nesting seabirds are restricted to modest numbers of Brandt's Cormorants and Western Gulls at the northwest end.

Maintenance and even recovery (as seen in the pelicans) of these populations of seabirds is possible if they are not subjected to disturbance or pollution.

D. Distribution, Numbers, and Seasonal Dynamics

Data concerning 64 species of marine birds were collected in the first year of the 1975-1976 study. An understanding of distribution and seasonal dynamics varied with the number of sightings of each species. In order

to give an overview of seabird activity throughout the first year of study, quarterly accounts of the major faunal groups, emphasizing those taxa that contributed significantly to the density of the avifauna as a whole are presented here. Frequency of sightings of all species on and near Channel Islands beaches are given in Table II.D-1.

1. April-June 1975: These months included the migratory periods of most purely transient and wintering species, the arrival of several species that summered but did not nest in the area, and much of the courtship, nest-building, egg-laying and incubation phases of the reproductive seasons of the nesting species. Surface water temperature varied from 10°C (50°F) San Miguel Island to 15°C (58°F) near Santa Catalina and San Clemente Islands and from San Diego south (unpublished data U.S.C.G. 1975).

Much migratory activity was seen in the Santa Cruz Basin, near the inter-island channels, and in the San Pedro Channel. These areas all harbored large to very large numbers of Sooty Shearwaters, Northern Phalaropes, Arctic Loons and Surf Scoters, many of which rested or fed in the waters close to the northern islands. Most Common and Red-throated Loons, Western and Eared Grebes, and Brandt probabaly passed within 15 km (9 miles) of the mainland coast, rather than farther offshore.

Santa Barbara Channel and the waters of Santa Cruz Basin provided major foraging areas for the nesting species of the northern four islands and San Nicolas and Santa Barbara Islands. (These six islands support a large percentage of the seabirds nesting in the study area.) Most of the nesting species--the three cormorants, Brown Pelican, Xantus' Murrelet, and Pigeon Guillemot--were found predominately within 10 km (6 miles) of their colonies, while Cassin's Auklets concentrated from 10 to 25 km (6 to 16 miles) offshore (principally north of their San Miguel Island colonies).

Migrants such as loons, grebes, ducks, and phalaropes were found in the waters east of longitude 118°30'W in moderate numbers and the several species that nest on the eastern islands and Los Coronados were present in low numbers as well. High densities of Xantus' and unidentified murrelets were seen east of San Clemente Island in May. The intrusion of warm water into this area from May onward (unpublished data U.S.C.G. 1975) correlated with a decline in overall density of birds in June through October.

The waters south and southwest of Santa Barbara Island were not sampled in April or May. By late June, only Sooty and Pink-footed Shearwaters were present there in substantial numbers.

Mainland beaches harbored relatively large numbers of gulls, primarily Western and California, Western Grebes, and Surf Scoters. As was the case throughout the year, the highest total counts of birds were found at the northern (Ventura County) and central (Los Angeles and Orange Counties) beaches.

Northbound migrants completed their exodus from Southern California waters in the last two weeks of this period.

2. July-September 1975: This was a period of transition from reproductive to migratory and dispersal activities among the nesting residents, and passage out of or through Southern California by summer visitors and fall migrants.

First representative sampling of waters beyond the continental edge (Patton Escarpment) revealed low overall densities; Sooty Shearwaters and migratory Arctic Terns and Sabine's Gulls accounted for most of the sightings in the deep-water offshore areas.

The greatest numbers of birds were found in the Santa Barbara Channel, Santa Cruz Basin and neighboring waters (particularly those overlying the northern Santa Rosa-Cortes Ridge) and between Santa Barbara Island and Tanner Bank. These were areas in which surface water temperatures varied from 13.5° (56°F) to 16-17°C, (61-63°F) several degrees cooler than the waters of the Gulf of Santa Catalina (this study unpublished U.S.C.G. 1975). The two groups of birds that contributed most heavily to these concentrations were Sooty and Pink-footed Shearwaters and the nesting species.

Because these three months included the nestling, fledging, and dispersal periods of the nesting seasons of several resident species conspicuous changes in their distribution and behavior were observed. Among the six northern and central islands, nesting birds were rather closely tied to the immediate vicinity of their colonies in July. Foraging Western Gull adults and a few Cassin's Auklets were observed at distances up to 35 km (22 miles) from the nearest colonies but the majority of sightings of both species were much closer to land. The three cormorants, Brown Pelican, and Pigeon Guillemot were only found along the shores of the nesting islands or a few kilometers out to sea. This distribution of foraging activity and of total sightings probably reflects the time-energy budgets of nesting birds, the distribution and availability of food sources, and the necessity of periodic return by parents to colonies to feed young.

The greatest total numbers of Western Gulls, Brown Pelicans, and Cassin's Auklets were found northwest of San Miguel Island, in the eastern end of Santa Barbara Channel, close inshore around all eight islands, and in the waters overlying the northern Santa Rosa-Cortes Ridge and Santa Cruz Basin.

Late in the period, fairly large numbers of Western Gulls and Brown Pelicans were found at sea in Santa Monica Bay and San Pedro Channel. Fledging of young Xantus' Murrelets from the sizable colony on Santa Barbara Island took place in April and May. This species is virtually absent from the study area from July through December.

In July and early August Sooty Shearwaters massed in great numbers--in some areas hundreds of individuals per $km^2$--to the west and northwest of San Miguel Island, South of Santa Rosa and Santa Cruz Island, (where birds streamed by the thousands), and in open water along the Santa Rosa-Cortes Ridge, Santa Cruz Basin and near Tanner Bank. Apparently, either there was a continual influx of birds from outside the Southern California Bight or many birds spent the summer months in the area.

Major changes in distribution and species composition of the avifauna took place in late August and September. The importance of the northern section of the Santa Rosa-Cortes Ridge and Santa Cruz Basin as an area of tremendous concentrations of seabirds and (and cetaceans and pinnipeds as well) declined progressively through August, reflecting a decline in shearwater abundance. Instead, many species concentrated near Tanner and Cortes Banks in late September. This area harbored major concentrations of Sooty Shearwaters in early August (this species became progressively less abundant in September), Leach's and Black Storm-Petrels in both August and September, and Western Gulls throughout this period. It was this area (along with the region between San Miguel Island and Rodriguez Seamount) in which southbound migrants such as Northern Phalaropes, Pomarine Jaegers, Sabine's Gulls, and Arctic Terns, together with rarities such as the South Polar Skua and Black-footed Albatross were found in the greatest numbers.

The open-ocean waters of the Gulf of Santa Catalina again harbored relatively few birds. Surface water temperatures reached the yearly high in this period; temperatures of 20°C were recorded in several spots in the Gulf, while 150 km (93 miles) to the northwest (near San Miguel Island) the water was 3° to 7°C cooler (unpublished data U.S.C.G. 1975). Migratory shorebirds such as Whimbrels (Numenius phaeopus), dowitchers (Limnodromus, sp.) and phalaropes, in addition to scoters, were seen passing southeast through this area in September. As in the preceding several months, storm-petrels were found near Forty-mile Bank, Southeast of San Clemente Island. This area is well known for concentrations of pelagic birds from August through October (McCaskie 1968, 1970, 1972, 1974).

Throughout the summer months the mainland beaches that were surveyed, harbored many hundreds of Western, Ring-billed and California Gulls.

Numbers of several of the species that dispersed northward into Southern California (Brown Pelican, Heermann's Gull, Elegant Tern) peaked on mainland beaches in August and September, as did Double-crested Cormorants

and caspian Terns. Small numbers of Western Grebes and Surf Scoters appeared at Mugu Lagoon in these months, indicating the onset of the southward migration.

3. October-December 1975: Fall migration extended through October and November. By the end of November, most winter residents of the Southern California Bight were present in large numbers and the species that entered the area some months earlier from Mexican waters began to return to the south. Nesting residents of the Channel Islands either remained in the vicinity of their colonies (the three cormorants, Brown Pelican, Western Gull), dispersed to open-ocean waters and the main-- still within the study area--(Brown Pelican, Western Gull, Cassin's Auklet), or left the study area (Pigeon Guillemot, Xantus' Murrelet). The winter ranges of the last two species and the Ashy Storm-Petrel are hardly understood.

Shearwaters were almost absent in these months. Only southwestward migratory movements of Sooty Searwaters, are redetected lending credence to the proposal of Pyle and DeLong (1968 ms) that the autumn migration of this species off California consists of birds from the nesting populations of the southwestern Pacific.

Bird density was very high throughout the Santa Barbara and San Pedro Channels. Fewer birds were found elsewhere inshore of the Santa Rosa-Cortes Ridge and density was very low in the oceanic waters beyond the Patton Escarpment. The primary contributors to the high densities in the channels included Western, Bonaparte's and California Gulls, and Brown Pelicans. The latter two gulls were found in moderate to low densities in offshore areas as well. Large numbers of Western Grebes concentrated in the eastern end of Santa Barbara Channel and in inshore waters south along the mainland to San Diego.

Very large numbers of Brown Pelicans were found in these months on roosts throughout the islands. Most of these were found on the northern islands in October. A shift southeastward occurred in November (detected primarily at sea), concurrent with rough weather west of Santa Cruz Island. It is not clear whether the heavy seas and northwest winds of mid-November were the main causative factor in this shift, however, in that the majority of the pelicans from Mexican colonies pass southward through and out of the study area by the end of December (Anderson and Anderson 1976).

Counts of several other species on the islands reach their yearly peaks from October to December. Many on the northern islands and at San Nicolas Island. Royal Terns were common at Santa Rosa, Santa Cruz, and San Clemente Islands.

Counts of birds along mainland beaches indicated that a number of winter-resident species were moving into the area. Among these were Arctic and Red-throated Loons, Western and Eared Grebes and Surf Scoters, all of

Table II.D,-1

Frequency of sightings of all species combined (total individuals) on and near Channel Island beaches, April 1975 through March 1976. Numbers in parentheses refer to specific locations on the islands. Dash indicates area not surveyed or or survey incomplete.

| Location / Date-- Type-- | Apr-Jun 75 | Jul-Sep 75 | Oct-Dec 75 | Jan-Mar 76 |
|---|---|---|---|---|
| SAN MIGUEL IS. | | | | |
| Richardson Rk. (103) | 102 | 233 | 179 | 93 |
| West (102, 110-20,160,170) | 1427 | 1313 | 1365 | 810 |
| South (146-51) | 304 | 194 | 372 | 216 |
| East (101,140-45) | 1846 | 894 | 1616 | 755 |
| North (121-40) | 130 | 272 | 245 | 281 |
| SANTA ROSA IS. | | | | |
| West (611-12,625) | 289 | 288 | 1563 | 633 |
| South (620-24) | 80 | 116 | 613 | 2756 |
| East (618-19,629) | 437 | 653 | 626 | 1136 |
| North (610,613-17) | 691 | 822 | 734 | 546 |
| SANTA CRUZ IS. | | | | |
| West (641,658) | 163 | 274 | 749 | 186 |
| South 650,653-56) | 230 | 442 | 783 | 1454 |
| East (649,651) | 375 | 356 | 928 | 173 |
| North (640,643-48) | 582 | 448 | 632 | 502 |
| ANACAPA IS. (670-90) | 1865 | - | - | 7482 |
| SAN NICOLAS IS. | | | | |
| Northwest (210-60) | 140 | 578 | 1756 | 1513 |
| Southwest (203) | 69 | 25 | 78 | 95 |
| Southeast (202) | 37 | 0 | 1608 | 944 |
| Northeast (201) | 127 | 477 | 302 | 416 |
| SANTA BARBARA IS. (300-330) | 1187 | 597 | 2141 | 813 |
| SANTA CATALINA IS. | | | | |
| Northwest (506-07,515,525-27) | 11 | 63 | 103 | 852 |
| Southwest (503-05,529) | 84 | 40 | 120 | 1171 |
| South (502,523-24) | 48 | 13 | 24 | 94 |
| East (501,509-11) | 43 | 54 | 34 | 1620 |
| Isthmus (508,521-22) | 56 | 65 | 41 | 1096 |
| SAN CLEMENTE IS. | | | | |
| Northwest (409-11) | 303 | 571 | 790 | 2141 |
| West Central (406-11) | 66 | 130 | 611 | 579 |
| Southwest (404-05) | 18 | 42 | 161 | 107 |
| Pyramid Cove (402-03) | 10 | 29 | 40 | 0 |
| East (401,412) | 30 | 0 | 0 | 16 |

which are known for their vulnerability to contamination by floating oil in nearshore waters. All of these species became more abundant along mainland beaches as the winter progressed.

Several species that predominated in the open-ocean waters of the study area in winter were not yet numerous in October and November. Few Northern Fulmars, Black-legged Kittiwakes or Rhinoceros Auklets were recorded in these months. Common Murres appear uncommon and are restricted to the vicinity of the Santa Barbara Channel.

4. January-March 1976: The winter of 1976 was notable for its extremely mild weather: very few fronts pushed through the area, rainfall was scant, and winds and sea conditions were moderate to light through the months of December through March. Surface water temperature varied from 11° to 13.5°C (52° to 56°F) depending on location (U.S.C.G. 1975). In general, the density of seabirds throughout the study area reached its high point in January, reflecting a tremendous influx of birds from northern and inland nesting areas. Several geographic areas had very high bird densities: Santa Barbara Channel, Santa Monica Bay, the entire Santa Rosa-Cortes Ridge, and inshore waters along the Los Angeles, Orange and San Diego County coasts. Moderate numbers of birds were found almost everywhere else, except well offshore beyond the continental margin where total densities were comparatively low.

The major concentrations in open water were comprised of two different assemblages of species. The majority of birds in eastern Santa Barbara Channel consisted of Arctic Loons, Western Grebes, California and Western Gulls and Common Murres. These species, along with Bonaparte's Gulls also predominated in Santa Monica Bay and San Pedro Channel. Each of these areas is rather close to the mainland and has a shallow seabed.

On the other hand, the concentrations encountered on the northern Santa Rosa-Cortes Ridge, near Tanner and Cortes Banks, and at Santa Catalina Islands were mainly Northern Fulmars, Black-legged Kittiwakes, California and Western Gulls, and Cassin's and Rhinoceros Auklets. The main attractant in the first and last of these three areas was apparently squid spawning activity. The great majority of birds seen more than 20 km (12 miles) off the mainland throughout the winter was of these latter species.

The winter of 1976 was clearly one of high relative abundance of Northern Fulmars and Black-legged Kittiwakes; both species are known for considerable variation in year-to-year abundance. (Rhinoceros Auklets may fit this descripition as well, but little information exists about their wintering habits in Southern California waters). Interestingly, Cassin's Auklets declined in number with increasing distance from San Miguel Island, while the larger Rhinoceros Auklet was most abundant in offshore waters more to the south and was even found in large numbers east and south of San Clemente Islands.

Birds were moderately abundant everywhere east of longitude 118°30'W at distances of 10 to 90 km (6 to 56 miles) off the mainland. Kittiwakes Northern Fulmars, and Rhinoceros Auklets predominated here and were replaced by loons, Western Grebes, and several species of gulls (Western, California, Ringbilled, Bonaparte's) in waters closer to the coast.

Relatively large numbers of Brandt's Cormorants and Western and California Gulls were found on Channel Islands roosts in January through March. Diving birds (Arctic Loon, Eared Grebe, Surf and White-winged Scoters) were also quite common inshore around the northern islands at this time. Owing to distance from land or perhaps oceanographic conditions, the diving birds noted above did not appear in large numbers at San Nicolas, Santa Barbara, or San Clemente Islands. BRown Pelicans decreased in number in inshore waters, refelecting the continued southward migration of birds in Mexican colonies.

Numbers of birds on and near mainland beaches were high in the months of January to March. Many of the same species that predominated near the shores of the islands were also abundant along the mainland. Arctic, Common and Red-throated Loons, Eared and Western Grebes, Surf Scoters, and Western, California, Ring-billed and Bonaparte's Gulls were found in large numbers from McGrath State Beach to Dockweiler State Beach, were somewhat less abundant along Orange County shores, and were abundant near San Diego. The latter area is known as a wintering area of great importance for loons, grebes, and diving ducks (J. R. Jehl, Jr. personal communication, cited in Norris, et al., 1976).

In March a general decrease in abundance and concurrent shift toward northern areas (Santa Monica Bay, Point Mugu, eastern Santa Barbara Channel was detected among the species that were most abundant along the central and southern beaches. No such relocation appeared to occur among the species that were found farther offshore until several months later.

CHAPTER III

# III. MARINE MAMMALS OF THE SOUTHERN CALIFORNIA BIGHT

## A. Introduction

Information in this section is provided on the distribution and movement, feeding habits and ecology, social and reproductive behavior, annual population cycles and known areas of movement, breeding, haulout (pinnipeds) or migration. These data are intended to provide more detailed site and species specific information to assist impact assessment.

## B. Pinnipeds

### 1. California Sea Lion (Zalophus californianus)

#### Range, Distribution and Movements

California sea lions range from Mazatlan, Baja California, Mexico to British Columbia (Peterson and Bartholomew 1967). Mate (1967) describes their non-breeding range as extending from at least 19°N latitude to 51°N latitude.

California sea lions breed on the islands in the Gulf of California and southward on the coast of Sonora, Mexico, on islands off the coast of Baja California, and on the Channel Islands in the Southern California Bight. The northernmost rookery is on San Miguel Island. However, a few pups have been produced on southeast Farallon Island in recent years.

In the non-breeding season, males occur by the hundreds, and sometimes thousands, along the coast of Northern California (Orr and Poulter 1967, Lance and Peterson 1968), Oregon and Washington (Mate 1975), and British Columbia (Hancock 1970, Bigg 1973).

Most animals are found in the vicinity of the rookeries during the summer breeding season but disperse in the fall and winter. A migration of males from southern rookies northward into the Bight may be a regular feature of the yearly cycle. Bartholomew and Boolootian (1960) found that in the California Channel Islands, the winter population of males exceeded the summer population and the summer population of females exceeded the winter population.

The migration of males from the Bight northward in the autumn is well documented. Hubbs (cited in Orr and Poulter 1967), Braham (1974), Orr and Poulter (1965), and Mate (1975).

## Feeding Habits and Ecology

The role of the California sea lion as a predator of commercially valuable fish has been a source of controversy for decades. Despite this attention, very little is known of its food and feeding habits. Bonnot (1928b) summarized the current knowledge on prey species and concluded that California sea lions prefer squid; however, when squid are not available, fish are readily consumed. He noted that the majority of fish eaten were of little commercial value, and in some cases, the sea lions consumed fish that were predators of harvested species. In Monterey Bay at least, California sea lions are major predators of salmon in the spring and summer months (Briggs and Davis, 1972).

California sea lions apparently are opportunistic feeders accepting a wide variety of fish and mollusks. Sheffer and Neff (1948) found squid, small fish and rocks in the stomachs of four California sea lions killed on Santa Barbara Island in the winter. Fiscus and Baines (1966) analyzed the stomach contents of seven California sea lions taken at sea. Six of the stomachs contained food items: three animals, feeding near Santa Rosa Island, contained squid (Loligo), two animals, taken near san Miguel Island, contained squid and hake (Merluccius), and one animal, taken south of Point Buchon, contained anchovy (Engraulis). The same authors noted that California sea lions feed in large groups when schooling fish or squid are available and probably disband when the food source is scattered.

## Social Structure and Reproductive Behavior

California sea lions pup and breed on both sandy beaches and rocks. More important in the choice of a rookery site is the requirement that the area be undisturbed by human activity. Peterson and Bartholomew (1967) stated that the sea lions on San Nicholas Island abandoned some rookery locations due to nearby military operations.

## Population Size and Trends

California sea lions associated with rookeries in Mexican waters probably number nearly as many as those in the Southern California Bight. Rice, Keyon and Lluch (1965) estimated the population, on Islas San Benitos and Cedros alone, at 16,565 in 1965. The population in the Gulf of California was estimated to be 5,411 in the spring of 1966 (Orr, Schonewald and Kenyon 1970). Scheffer's (1958) estimate of a world population between 50,000-100,000 seems realistic.

## Status of the California Sea Lion in the Southern California Bight

It is likely that more California sea lions are found within the relatively small area of the Southern California Bight than in the rest of its range combined. In the summer breeding season when these animals are concentrated in the vicinity of their rookeries, the size of the population and its growth can be most easily compared. Table III-1 summarizes the censuses of California sea lions on the islands of the Southern California Bight during the months of June and July. Clearly, the population has shown a ten-fold increase in numbers in about 40 years. Further conclusions should be drawn cautiously from this summary because of the extreme variation in census techniques employed, the coverage, and the dates on which the censuses occurred.

## Annual Cycle and Pattern of Haul-out

California sea lions are year-round residents of the Southern California Bight. They are abundant and rather widely distributed throughout the area. In total numbers counted, there is much variation from season to season. In the spring, the population increases as animals enter the area for pupping and breeding while in the late summer and fall, the population decreases markedly as animals leave the area. In other words, numbers change because the population being studied is not limited in range to the Bight and uses the resources of this area in a predictable seasonal pattern.

Table III-1 Summary of censuses of California sea lions during the summer breeding season in the Southern California Bight, 1927 to 1971. Total numbers given include pups; pup counts if available are within parentheses.

| Source | Date | SMI | SNI | SBI | SCL | Other | TOTAL |
|---|---|---|---|---|---|---|---|
| Bonnot, 1928 | June-July, 1927 | 149 | nc | 125 | 264 | 247 | 785 |
| " | June-July, 1928 | 429 | nc | 327 | 251 | 220 | 1227 |
| Bonnot, 1931 | June-July, 1930 | 205 | nc | 8 | 347 | 174 | 734 |
| Bonnot, 1937 | June-July, 1936 | 520 | nc | 600 | 435 | 211 | 1766 |
| Bonnot et al., 1938 | June-July, 1938 | 714 | nc | 500 | 490 | 150 | 1854 |
| Bonnot and Ripley 1948 | June-July, 1947 | 630 | 680 | 1000 | 250 | 120 | 2680 |
| Bartholomew, 1951 | June 18-20, 1949 | | 2453 (433) | | | | |
| Bartholomew, 1951 | July 9-11, 1949 | | 3553 (895) | | | | |
| Bartholomew, et al., 1951 | June 21-23,1950 | | | 2534 (647) | | | |
| Bartholomew and Boolootian, 1960 | June 9-11, 1958 | 8179 (170) | 3812 (281) | 1616 (2) | | 238 | 13845 (453) |
| Ripley et al,1962 | June-July, 1958 | 5192 | 3074 | 1847 | 1507 | 999 | 12619 |
| " | June-July, 1961 | 9512 | 4637 | 1760 | 2361 | 93 | 18363 |
| Odell, 1971 | June 12-20,1964 | 14351 (1195) | 12748 (2300) | 3282 (220) | 3820 (183) | 181 | 34382 (4598) |
| Carlisle and Aplin, 1966 | June 1-3, 1965 | 11641 | 1900 | 1100 | 1900 | 628 | 17169 |
| Peterson and Bartholomew, 1967 | June 1-4, 1965 | | 8140 (2359) | | | | |
| | July 4-6, 1965 | | 9375 (3604) | | | | |
| Frey and Aplin, 1970 | June 3-6, 1969 | 7734 | 7935 | 654 | 667 | 461 | 17451 |
| Odell, 1972 | June 3-5, 1969 | | 9288 (1129) | | | | |
| " | June 14-15, 1969 | | 11735 (2679) | | | | |

Table III-1 (Cont'd)

| Source | Date | SMI | SNI | SBI | SCL | Other | TOTAL |
|---|---|---|---|---|---|---|---|
| Carlisle and Alpin, 1971 | June 9-17, 1970 | 9835 | 6240 | 484 | 949 | 539 | 18047 |
| Odell, 1972 | July 3-4, 1970 | | 9793 (2271) | | | | |
| " | July 3-5, 1971 | | 12341 (3500) | | | | |

SMI=San Miguel Island; SNI=San Nicolas Island; SBI=Santa Barbara Island; SCL=San Clemente Island; nc=No census.

The basic features of the annual cycle of the California sea lion in the Bight are shown in Figure III-1.

The total population numbers, based on the censuses of California sea lions hauled-out on land, are shown in Table III-2. At the peak of the summer pupping and breeding season, there were over 38,000 animals counted in 4 days of aerial survey. Of these, about 15,000 were pups of the year. Thereafter, the population declined in numbers and in subsequent censuses seemingly stabilized at about 22,000. At the time of the first area-wide winter census, the total population on land numbered less than 16,000. In the spring, the population slowly increased as animals of all age and sex categories began their return into the area.

The activities of California sea lions take place primarily on four islands in the Bight - San Miguel, San Nicolas, Santa Barbara, and San Clemente Islands (Figures III-2 through III-5). Census results are presented in Table III-2. San Miguel and San Nicholas Islands are the most important locations to this species in terms of numbers on land. About 90 percent of all California sea lions counted on any survey were hauled out on these two islands. The pattern of haul-out for these locations is basically similar to the pattern shown in Figure III-1 for the entire area.

In general, the increases and decreases of the populations of California sea lions on the islands of the Bight are a function of the location of these islands and the direction of the seasonal movements of these animals through, out of, or into the area. California sea lions are gregarious and social; their hauling grounds are traditional gathering places. Few California sea lions are seen hauled out on the other islands of the Bight. These islands afford foraging sea lions a temporary resting place but apparently lack some basic features of an acceptable hauling ground. Further, California sea lions are closely tied to the land. They feed in waters relatively near their hauling ground. They are not pelagic, spending days at sea. Therefore, large-scale changes in numbers on land from season to season are most realistically explained as a reflection of movements relative to the boundaries of the Bight.

Movements

The Bight is only part of the range of the California sea lion. Within this portion of the range, however, all hauling grounds have been censused and it can be assumed that any increases or decreases in total number indicate a movement into or out of the Bight. This is also true of the total area-wide count of any age or sex category. From seasonal changes in numbers and compositions some basic patterns of movement can be inferred.

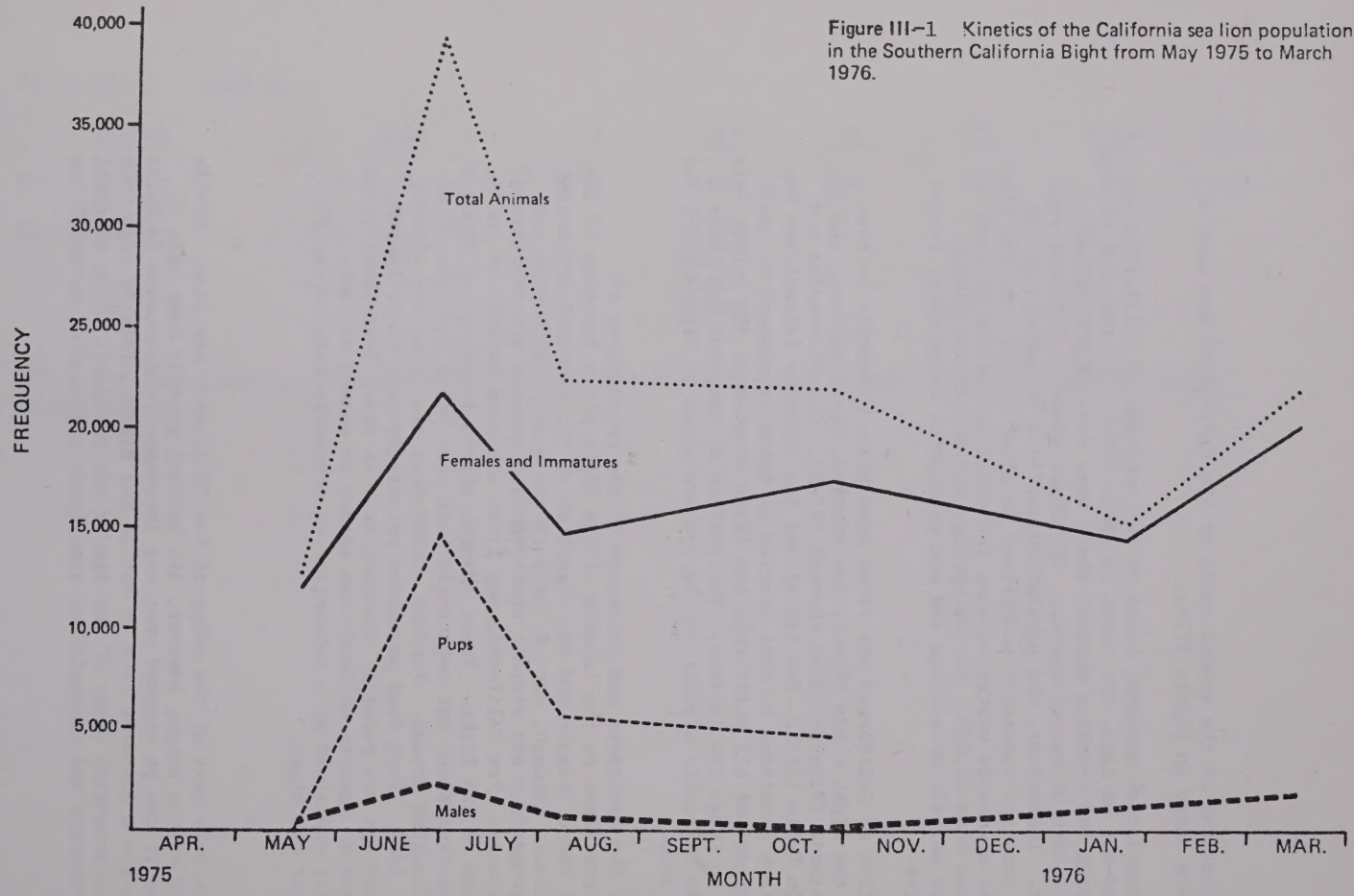


**Figure III–1** Kinetics of the California sea lion population in the Southern California Bight from May 1975 to March 1976.

Table III-2 Aerial censuses of California sea lions on the islands of the Southern California Bight, 1975-1976.

| Island | Dates of Survey | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 16-17 May | 27-30 June | 4-7 Aug | 23-26 Oct | 16-18 Dec | 6 Jan | 22-25 Jan | 13-15 Mar |
| San Miguel Is. | | | | | | | | |
| adult males | 68 | 1296 | 297 | 72 | - | 1503 | 503 | 575 |
| fem,juv,yrl. | 4783 | 11027 | 6468 | 10296 | - | 3735 | 6266 | 9752 |
| pups | 0 | 6236 | 2888 | 1840 | - | | | |
| total | 4851 | 18559 | 9653 | 12208 | - | 5238 | 6769 | 10327 |
| San Nicolas Is. | | | | | | | | |
| adult males | 238 | 722 | 347 | 57 | - | 431 | 792 | 1216 |
| fem,juv,yrl. | 4707 | 8629 | 6878 | 5565 | - | 4452 | 5580 | 7798 |
| pups | 0 | 7184 | 2969 | 2296 | - | | | |
| total | 4945 | 16535 | 10194 | 7918 | - | 4883 | 6372 | 9014 |
| Santa Barbara Is. | | | | | | | | |
| adult males | 20 | 81 | 53 | 40 | - | - | 5 | 1 |
| fem,juv,yrl. | 1188 | 1023 | 594 | 900 | - | - | 1049 | 1005 |
| pups | 0 | 684 | 418 | 54 | - | - | | |
| total | 1208 | 1788 | 1065 | 994 | - | - | 1054 | 1006 |
| San Clemente Is. | | | | | | | | |
| adult males | 38 | 87 | 184 | 13 | 56 | - | 189 | 48 |
| fem,juv,yrl. | 1106 | 1152 | 938 | 944 | 1277 | - | 1357 | 1811 |
| pups | 0 | 608 | 419 | 33 | | - | | |
| total | 1144 | 1847 | 1541 | 990 | 1333 | - | 1546 | 1859 |
| Santa Catalina Is. | | | | | | | | |
| adult males | 0 | 0 | 17 | 0 | - | - | 1 | 0 |
| fem,juv,yrl. | 2 | 0 | 0 | 0 | - | - | 25 | 16 |
| pups | 0 | 0 | 0 | 0 | - | - | | |
| total | 2 | 0 | 17 | 0 | - | - | 26 | 16 |
| Santa Rosa Is. | | | | | | | | |
| adult males | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| fem,juv,yrl. | 0 | 0 | 3 | 0 | 0 | - | 33 | 0 |
| pups | 0 | 0 | 0 | 0 | | - | | |
| total | 0 | 0 | 3 | 0 | 0 | - | 33 | 0 |
| Santa Cruz Is. | | | | | | | | |
| adult males | 0 | 0 | 48 | 0 | - | - | 0 | 0 |
| fem,juv,yrl. | 0 | 25 | 8 | 55 | - | - | 7 | 0 |
| pups | 0 | 0 | 0 | 0 | - | - | | |
| total | 0 | 25 | 56 | 55 | - | - | 7 | 0 |
| Grand Total | 12150 | 38754 | 22529 | 22165 | | | 15807 | 22222 |

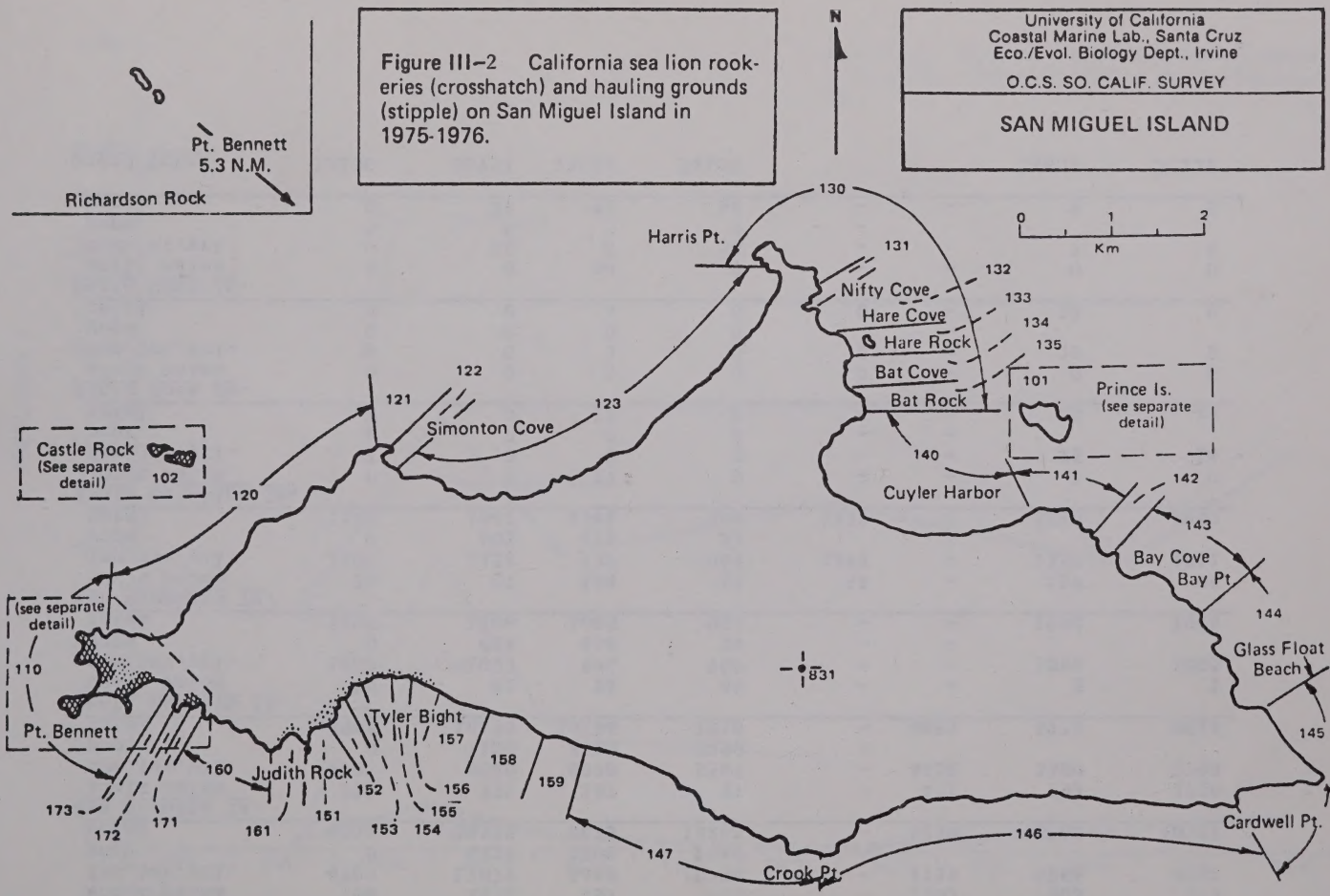


Figure III–2 California sea lion rookeries (crosshatch) and hauling grounds (stipple) on San Miguel Island in 1975-1976.

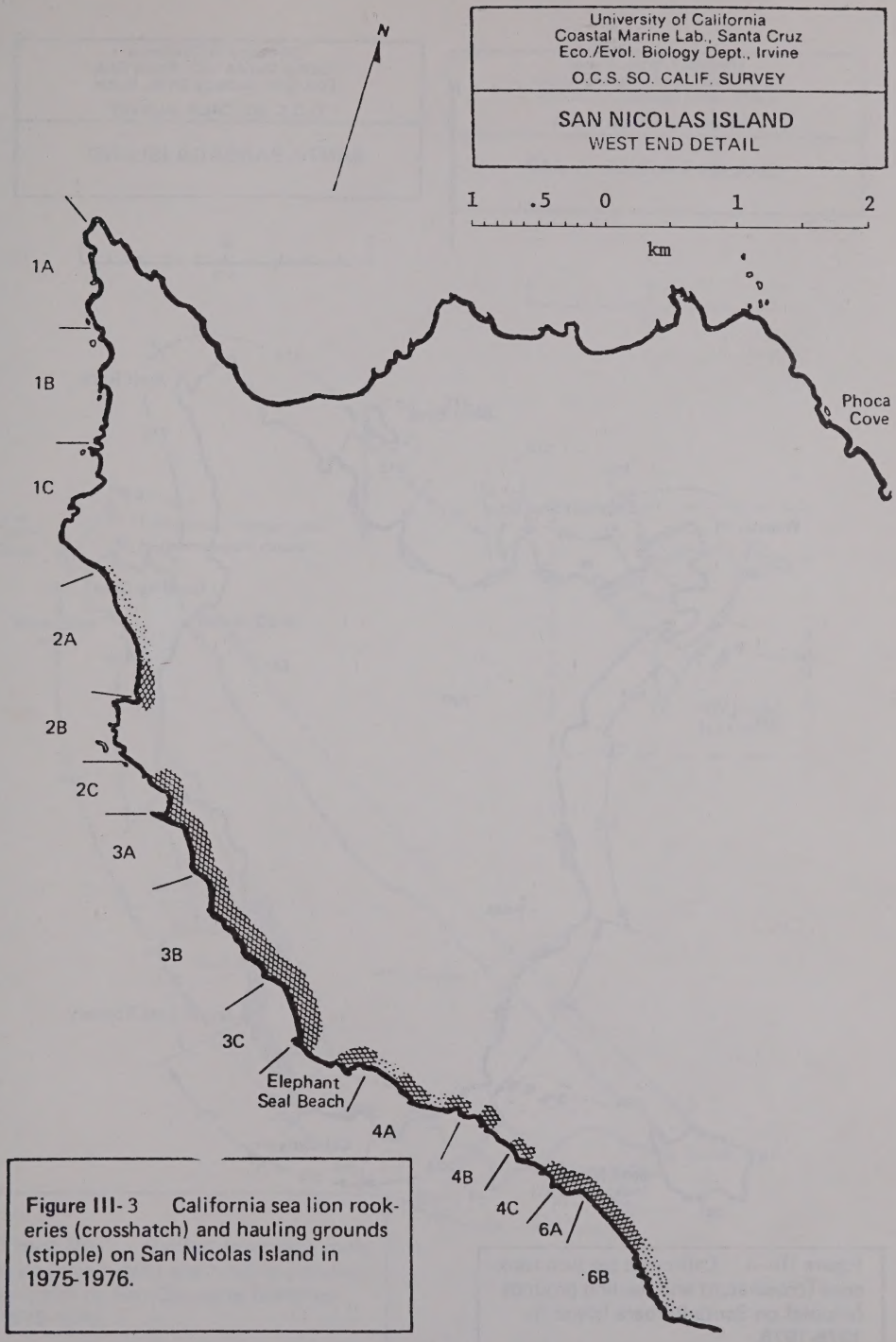


**Figure III-3** California sea lion rookeries (crosshatch) and hauling grounds (stipple) on San Nicolas Island in 1975-1976.

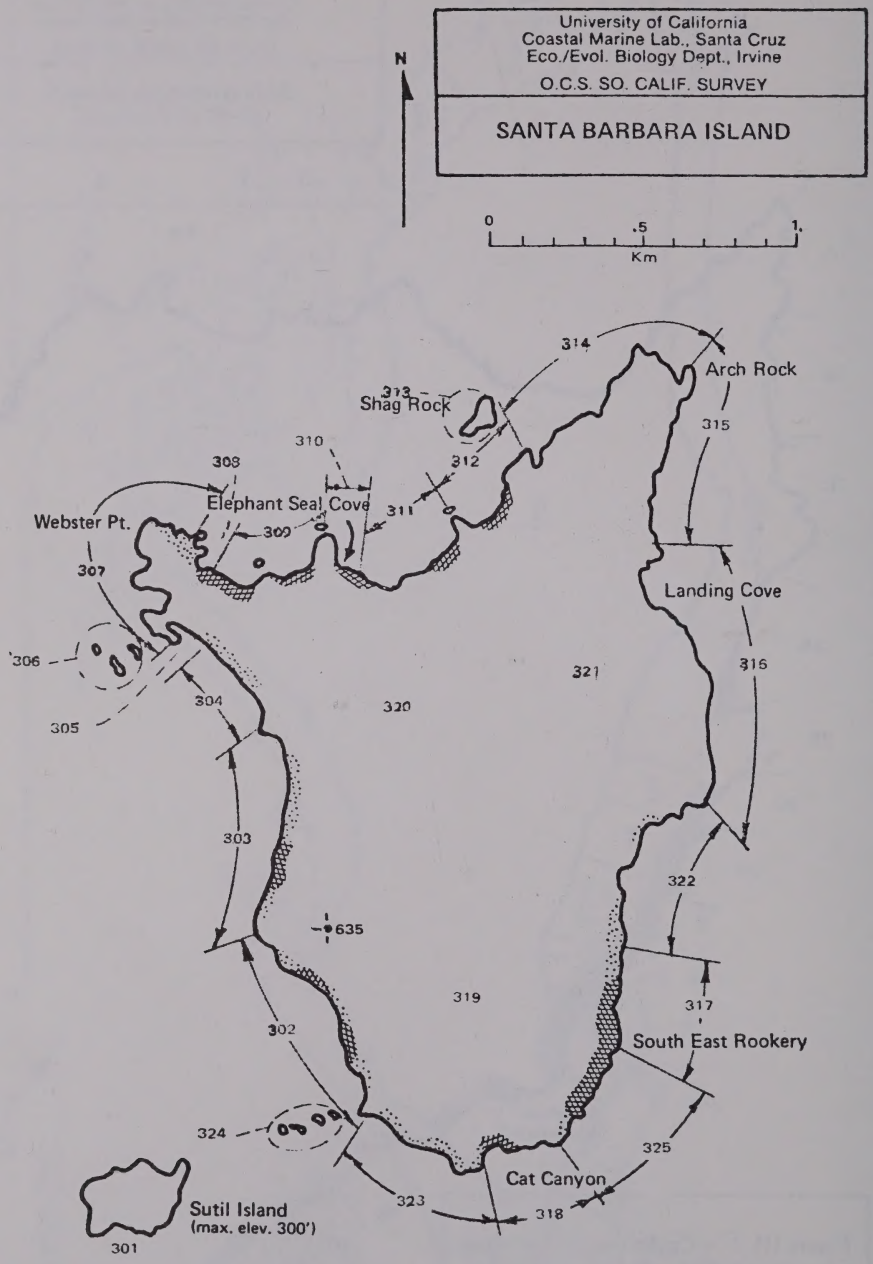


**Figure III–4.** California sea lion rookeries (crosshatch) and hauling grounds (stipple) on Santa Barbara Island in 1975-1976.

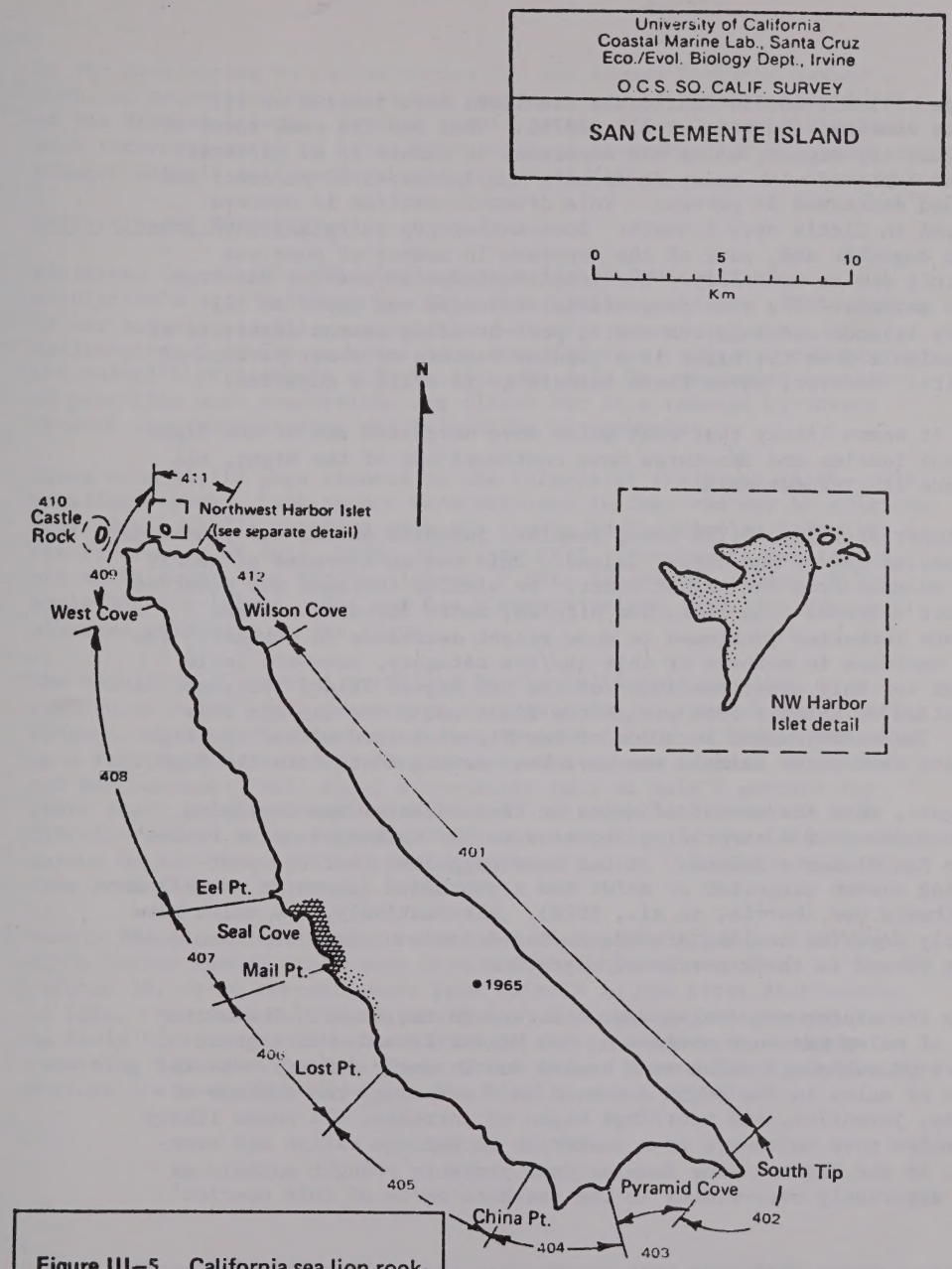


**Figure III–5** California sea lion rookeries (crosshatch) and hauling grounds (stipple) on San Clemente Island in 1975-1976.

In June of 1975, 38,754 California sea lions were counted on all islands combined (Norris, et al., 1976). This was the peak count of the year. By August, males had decreased in number by 61 percent; females combined with immature animals had decreased 32 percent; and pups had decreased 54 percent. This dramatic decline in numbers occurred in little over 1 month. Some mother-pup pairs may have gone to sea together and, part of the decrease in number of pups was certainly due to mortality. The total decrease in numbers was over 14,000 animals. The same proportional decrease was noted on all rookery islands and suggests that a post-breeding season departure of many animals from the Bight is a regular feature of their pattern of activity. However, where these animals go is still a question.

While it seems likely that most males move northward out of the Bight and many females and immatures move southward out of the Bight, all evidence is circumstantial.

In October of 1975, 10,296 young females, juvenile males, and yearlings were hauled out on San Miguel Island. This was an increase of nearly 4,000 animals from the August count. No similar increase was observed on other islands. In fact, San Nicolas, Santa Barbara, and San Clemente rookeries continued to show slight decreases in numbers. The total decrease in numbers of this age/sex category, however, could account for only about one-third of the San Miguel Island increase. A relocation of animals from within the Bight could not explain this peak. The northernmost location of San Miguel Island within the Bight suggests that these animals may have been moving south into the Bight.

In August, when the number of males on the rookeries was declining, observations show a surprising increase in the number of males hauled out on San Clemente Island. It has been suggested that the post-breeding season dispersal of males has a southward component as well as a northward one (Norris, et al., 1976). Alternatively, the males have recently departed hauling grounds on the islands of Baja California and simply paused in their northward migration.

During the winter many males were observed in the Bight. The winter peaks of males was most obvious on San Miguel Island, where great numbers of sub-adult males were hauled out in early January. As the number of males in the Bight declined in the spring, the numbers of females, juveniles, and yearlings began to increase. It seems likely that males move northward from rookeries in Mexican waters and over-winter in the Bight. Some females (and probably younger animals as well) apparently over-winter in the southern parts of this species' range.

The data suggest that most pups remain near the rookery in the first 4 months of life. Dispersion is slight through the winter and increases

in the late spring as adults arrive for the summer breeding season. Most tag recoveries during recent studies occurred at locations north of San Nicolas Island. Several yearlings and a few 2-year old animals were recovered north of Point Conception, indicating that at least some younger animals migrate northward out of the Bight.

Birthrate and Mortality

Birthrate is probably the single most reliable indicator of a population's size and health. More than simply a measure of the number of new animals added to a population, it is a measure of the inclination of adults to breed in a specific area. Adverse changes in the animal's environment will be seen not only in compounded mortality of pups (the most susceptible age class) but in a reduced birthrate through premature pupping and relocation of rookeries.

There were 14,712 pups counted on the islands of the Bight in the 1975 breeding season. Peak counts were obtained in June and may be slightly low. Odell (1972) recorded peak pup counts on San Nicolas Island in the first week of July, 1969, 1970, and 1971. The counts per island are as follows: San Nicolas Island, 7,184; San Miguel Island, 6,236; Santa Barbara Island, 684; and San Clemente Island, 608. No pups were observed elsewhere in the Bight.

The magnitude of natural mortality in the California sea lion is a particularly difficult paramenter to assess due to several complicating factors. During the breeding season, pup mortality is highly variable as a function of location, disturbance, and summer storms. Peterson and Bartholomew (1967) found a mortality rate of only 4 percent for their study area on San Nicolas Island. In contrast, Brownell and Schreiber found an average of 21 percent mortality in the 1968 breeding season on San Nicolas Island, with wide variation from beach to beach (see Brownell and Le Boeuf, 1971).

Nearly 75 percent of the tag recoveries during the first year of the BLM's Marine Mammal Study were from dead or injured animals. Of the 82 returns 38, or 46 percent, were from animals in the first four months of life. For dead California sea lions of known age, 68 percent died in their first year, 23 percent died in their second year, and the remaining 9 percent died in their third year. Figure III-6 graphically depicts the mortality curve for the first 3 years of life.

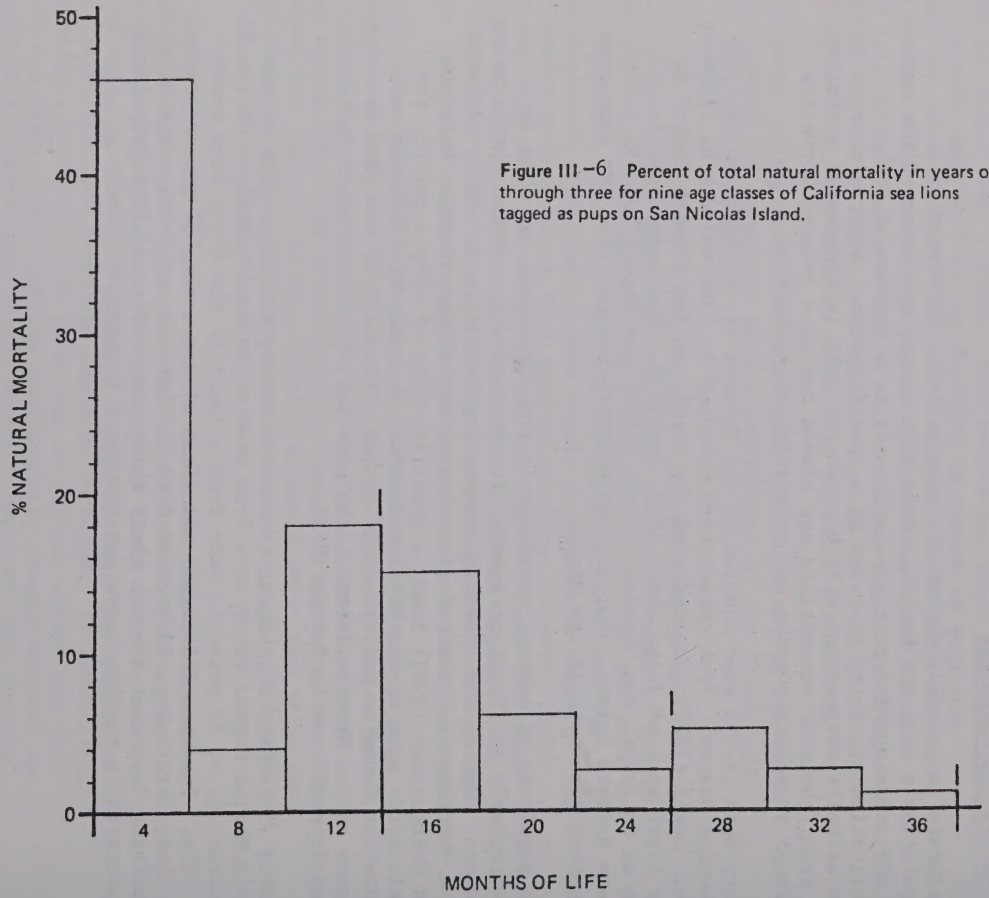


**Figure III-6** Percent of total natural mortality in years one through three for nine age classes of California sea lions tagged as pups on San Nicolas Island.

These percentages are useful only in emphasizing the fact that most of the mortality of California sea lion pups occur shortly after the animals are born.

The main causes of pup mortality on the rookery appear to be malnutrition, trauma, parasitism, gastrointestinal infection and miscellaneous infection (Brownell and Le Boeuf, 1971). Pups are also washed out to sea and drowned during storms.

Once at sea, most sea lion mortality is apparently parasite-related, especially during the first year of life (Brownell and Le Boeuf, 1951; Ridgway, Gervaci and Medway, 1975). The most commonly detected parasite species are the lungworm, Parafilaroides decorus, and the liver fluke, Zalophotrema hepaticum (Dailey, 1970; Bronell and Le Boeuf, 1971).

Leptospirosis, a spirochaete bacterial infection, and the San Miguel sea lion virus are two additional factors which have been implicated as probable causes of mortality and abortion in the California sea lion (Vedros, et al., 1971; Smith, et al., 1973; Smith, et al., 1974). Environmental pollutants may also be involved in premature births of pups; tissues of premature parturient females and pups investigated by DeLong, Gilmartin and Simpson (1973) contained levels of organochlorine pesticides and polychlorinated biphenyl residues two to eight times higher than similar tissues in full-term parturient females and pups.

Known predators of the California sea lion include the killer whale, Orcinus orca, and several species of shark (Heller, 1904; Rice, 1968; Brownell and Le Boeuf, 1971), which are common in waters around major rookeries. Rice (1968) reported the presence of sea lion remains in the stomachs of three out of nine killer whales taken in California waters, and this species has been observed in the vicinity of sea lion aggregations at sea during the first year of the study. Sea lions are often sighted bearing the marks of shark attacks, which probably account for a significant proportion of the at-sea mortality (Le Boeuf, personal observation).

Of course, man has long been a major sea lion predator. Although California sea lions are no longer taken commercially, individual animals are still occasionally killed by fisherman near fishing operations and by "sportsmen." Injured animals and carcasses showing gunshot wounds are occasionally encountered in the Bight area (Peterson and Bartholomew, 1967; Ridgway, et al., 1975; Norris, et al., 1976).

Distribution and Density of California Sea Lions at Sea

California sea lions are more commonly encountered at sea than any other species of pinniped in the Bight. In some parts of the Bight,

and especially at some times of the year, they are abundant; while in other waters, they are rare or absent.

Nine broad distributional zones within the Bight have been defined (Figure III-7). The boundaries of these zones serve only to partition major bodies of water according to known escarpments, ridges, and basins, and, to a lesser extent, the observed discontinuities in the distribution of major faunal groups.

Low densities were observed in all zones during the breeding season. California sea lions apparently remain on or near the rookeries much of their time and feed in waters nearby. Densities increased noticeably in the fall during the post-breeding season dispersal. High densities were found in the Santa Barbara Channel, Santa Rosa Ridge, Santa Cruz Basin near Santa Barbara Island and on Cortes Bank. By winter, densities in these zones decreased and some increase in density was noted near Santa Catalina Island over San Clemente Ridge, San Nicolas Basin, and Tanner-Cortes Banks. This shift may be related to winter squid spawning or movement of animals southward toward Mexican waters.

Some feeding areas used by California sea lions can be described in a general way based on sightings at sea where feeding behavior was exhibited, where the presence of birds on the water near sea lions suggested feeding activity, and also where large rafts of resting animals were observed. Most rafts of resting sea lions were observed near the rookeries on San Miguel, San Nicolas and Santa Barbara Islands (Norris, et al., 1976).

Rafts were also common on Cortes Bank, and, to a lesser extent, on the Santa Rosa Ridge. Feeding behavior recorded by shipboard observers was widely distributed throughout the study area. Most sightings, however, were of single animals. Feeding behavior exhibited by large aggregations of sea lions was observed most frequently at the northeastern rim of the San Nicolas Basin, the waters within 20 km (12.4 miles) of Santa Barbara Island, and Cortes Bank. Feeding was also recorded in the Santa Barbara Channel. In general, the areas where sea lions were frequently seen feeding or rafting, are also the areas of highest overall density regardless of behavior. Feeding was observed predominantly in the shallow waters near the island rookeries. The Santa Barbara Channel is apparently the most important feeding ground for animals associated with the San Miguel Island rookery during the summer breeding season. The northeastern rim of the San Nicolas Basin and Cortes Bank were also feeding grounds of major importance. These areas may be used by sea lions from the rookeries on San Nicholas, San Clemente, and even Santa Barbara Islands, and must be rich to attract animals such great distances.

California sea lion distribution at sea is patchy. The average density at sea is the 1975-1976 survey year was 0.65 animals per $km^2$ (about 200 km

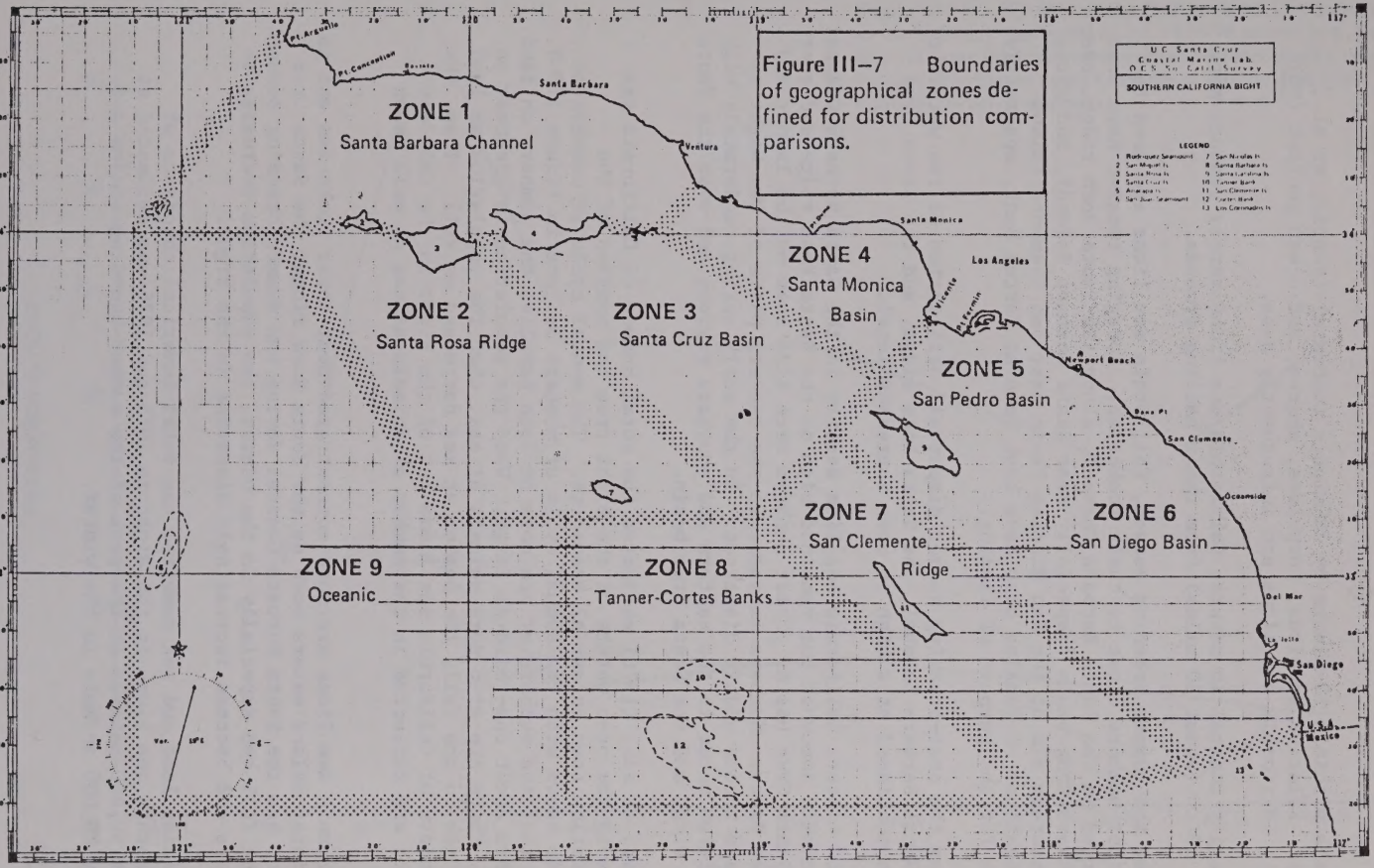


Figure III–7 Boundaries of geographical zones defined for distribution comparisons.

animals within a 10-minute by 10-minute quadrate) (Norris, et al., 1976). Relative to birds, porpoises, sharks, and ocean sunfish (Mola mola), California sea lions are infrequently seen.

Primarily coastal in nature, California sea lions rarely venture more than 50 km (about 30 miles) from their hauling grounds.

During the summer breeding season, California sea lions are seen in greatest numbers close to their rookeries. Foraging females have been observed in the Santa Barbara Channel, along the Santa Rosa ridge, over the Santa Cruz basin (especially near Santa Barbara Island), and along the eastern rim of the San Nicolas Basin near San Clemente Island. Aggregations of females also have been seen at Cortes Bank, apparently there for the purpose of feeding.

During the post-breeding season dispersal, utilization of the waters of the Santa Barbara Channel, the Santa Rosa ridge, and the Santa Cruz basin continued at a high or even increased level.

In the winter, California sea lion density in the Santa Barbara Channel diminished somewhat but remained high on the Santa Rosa ridge and over the Santa Cruz basin. Great numbers were also seen on the Tanner and Cortes Banks. Numbers increase in the eastern parts of the Bight as animals become widely dispersed. In the early spring, moderately high densities occur in the eastern and southern regions and over the Santa Rosa ridge and the Santa Cruz basin.

Norris, et al., (1976) estimated the total number of California sea lions in the open waters of the Bight from the samples of the population seen on aerial transects. The annual cycle of numbers at sea is shown with the annual cycle of numbers on land in Figure III-8. Note that the numbers at sea more or less parallel the numbers on land and are about one-third as large. When the population is greatest on land, there are also more animals at sea; when the population on land declines in the fall, the number at sea decreases as well. Thus, the movements of California sea lions out of the Bight in the fall and winter are reflected in the number of animals at sea as well as on land.

California sea lions are more concentrated near their rookeries and in the inter-island waters such as the Santa Rosa ridge, the Santa Cruz basin, and the Santa Barbara Channel during the summer breeding season. In the fall and especially in the winter, the population decreases in numbers and becomes increasingly dispersed in the Bight.

Combining land and sea numbers, the total numerical abundance of California sea lions in the Bight in 1975 and 1976 was estimated at about 50,000 animals at the peak of the summer breeding season and about 20,000 animals in the winter.

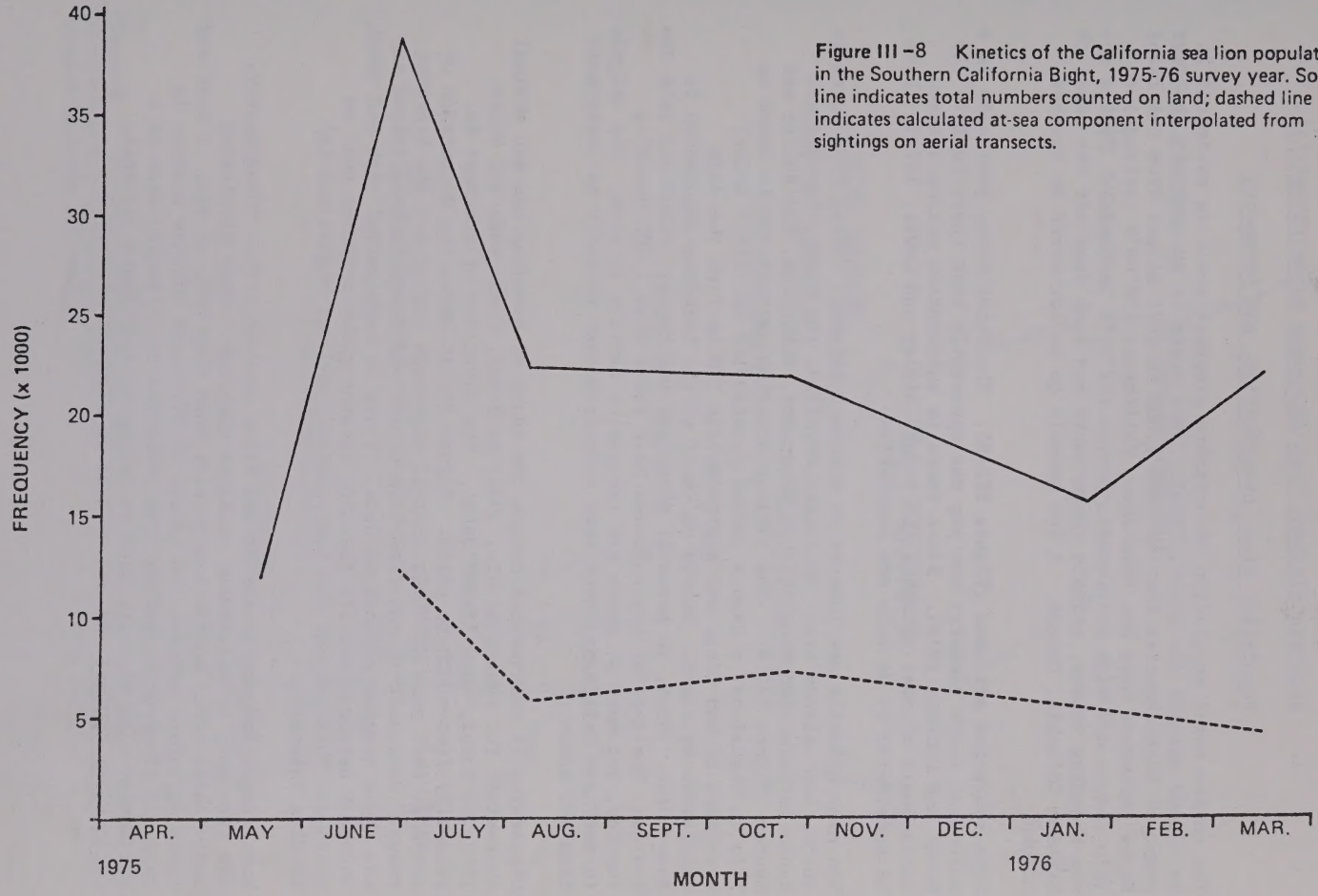


**Figure III–8** Kinetics of the California sea lion population in the Southern California Bight, 1975-76 survey year. Solid line indicates total numbers counted on land; dashed line indicates calculated at-sea component interpolated from sightings on aerial transects.

## 2. Northern Elephant Seal (Mirounga angustrirostris)

### Population Size, Distribution, and Movements

The entire world population of northern elephant seals is estimated to be 47,000 animals (Le Boeuf, 1976). They breed in an area off the west coast of North America that extends 1,000 km (621 miles) from the Point Reyes peninsula near San Francisco, California (38°66'N latitude) to Isla Cedros off Baja California, Mexico (28°05'N latitude). During the non-breeding season, animals range north and some feed off the coast of British Columbia, Canada. A few animals go as far north as Southern Alaska.

Nine rookeries are used (Figure III-9). The Point Reyes peninsula is a potential tenth rookery; one pup was apparently born there in 1976 (Le Boeuf and Panken, 1976). Since there is substantial mixing between individuals of most colonies (Le Boeuf, Ainley and Lewis, 1974), there is considered to be only one population.

The nine colonies are located on offshore islands. Going from north to south, the islands are: Southeast Farallon, Ano Nuevo, San Miguel, Santa Barbara, San Nicolas, Los Coronados, Guadalupe, San Benito and Cedros (Figure III-9). The largest breeding aggregation is found on Isla de Guadalupe, a remote island located 347 km (215.5 miles) southwest of San Diego and approximately 300 km from the Baja California mainland. Nearly one-half of the breeding population is found here. Next, in terms of size, are San Miguel Island and Isla San Benito. The rest of the colonies have fewer than 1,000 breeding females, but many of these are increasing rapidly in size. The islands in northern California have been colonized most recently by immigrants from the south.

Dispersion is substantial before the onset of breeding age and minimal thereafter (Le Boeuf, et al., 1974; Le Boeuf, Countryman and Hubbs, 1975; Le Boeuf, unpublished data). The direction of movement is primarily from south to north. Figure III-10 shows the dispersion of elephant seal pups on their initial sightings throughout the breeding range. Movements to and from Isla Cedros and Santa Barbara Island are not shown because of lack of data. There is substantial back and forth movement between colonies that are located close together such as Southeast Farallon and Ano Nuevo Island, and San Miguel and San Nicolas Islands.

Most dispersion occurs during the first year of life. Subsequently, the frequency of dispersion declines with age. Many dispersing individuals breed on the new rookery when they come of age. A back and forth migration between the island of birth and another rookery is rare. A clearcut migration from rookeries to a feeding area at a particular time of year, such as occurs in the Alaska fur seal, Callorhinus ursinus, is not evident in elephant seals.

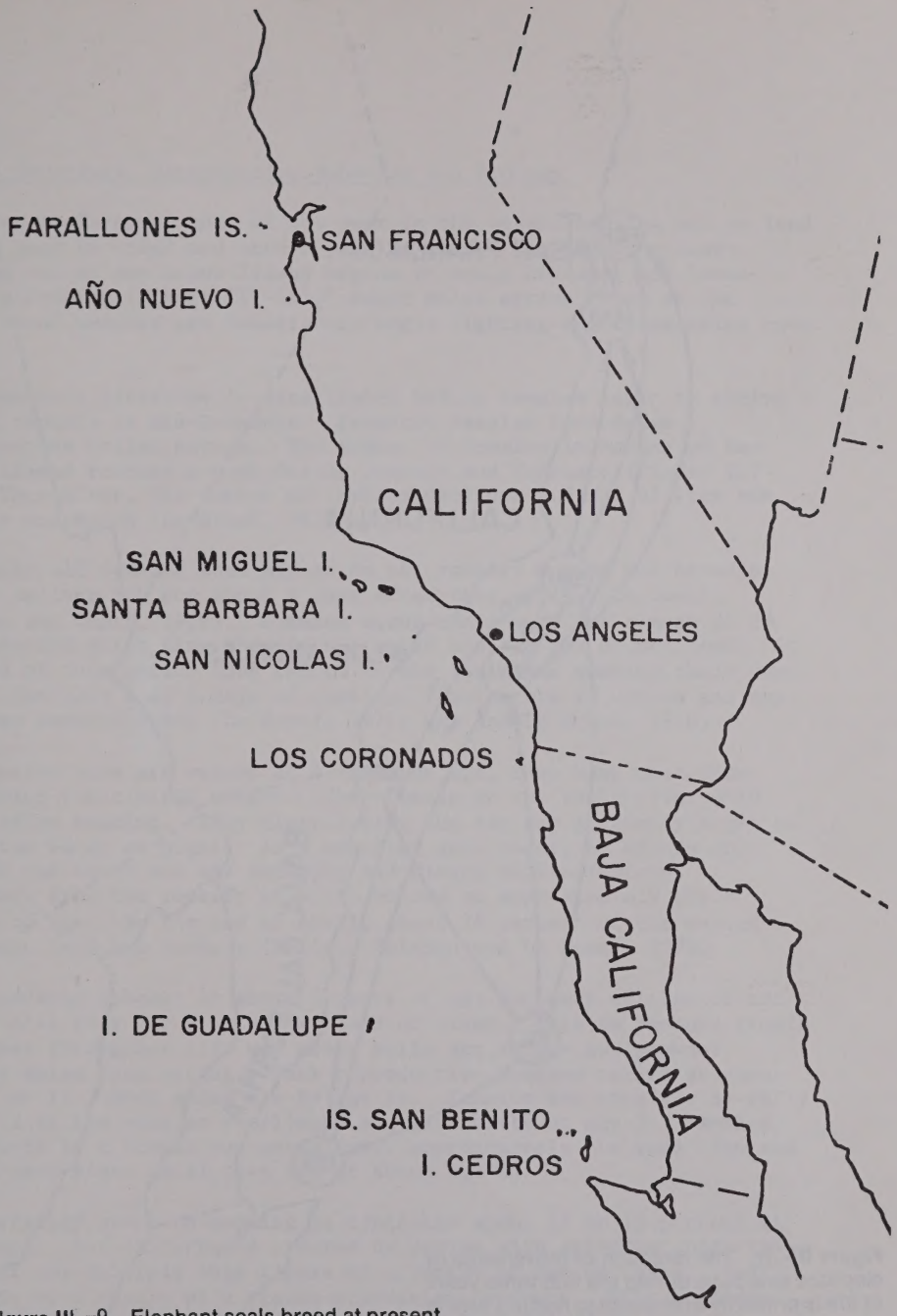


**Figure III –9** Elephant seals breed at present on nine islands or groups of islands off the coast of California and Mexico.

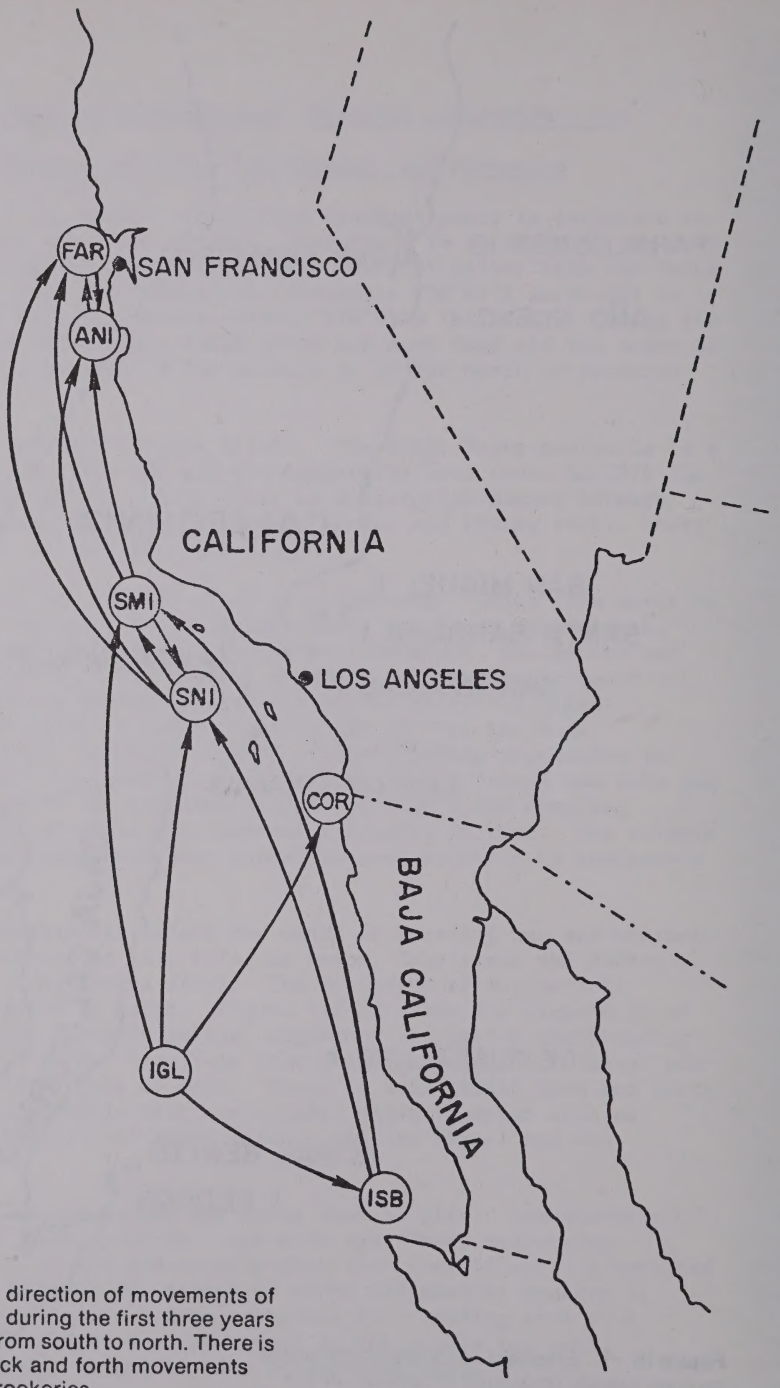


**Figure III-** 10 The direction of movements of elephant seal pups during the first three years of life is primarily from south to north. There is also substantial back and forth movements between adjacent rookeries.

Social Structure, Reproductive Behavior and Ecology

Elephant seals spend most of the year in the water, hauling out on land once a year to breed and once a year to molt. The breeding season hauling out on Ano Nuevo Island begins in early December and lasts until mid-March (Figure III-11). Adult males arrive first on the traditional beaches and immediately begin fighting and threatening each other.

The dominance hierarchy is established before females begin to arrive on the rookery in mid-December. Pregnant females form dense aggregations called harems. The number of females in harems on Ano Nuevo Island reaches a peak during January and February (Figure III-11). Thereafter, the number of females declines and all of them are gone by mid-March (Le Boeuf, 1972).

Virtually all females that appear on the rookery during the breeding season deliver one pup about 6 days after they arrive (Le Boeuf, Whiting and Gantt, 1972). Females nurse their pups for a mean of 28 days, during which time they do not enter the sea and do not feed. At the end of this period they return to the sea, thus weaning their pups. During the last 4 or 5 days of nursing, females are in estrus and may copulate several times (Le Boeuf, 1972; Cox and Le Boeuf, 1976).

By the time pups are weaned at 4 weeks of age, they have more than quadrupled their birth weight. They remain on the rookery for 8-10 weeks after weaning. They sleep during the day and gradually begin to enter the water at night. As a weanling gets older, he spends more time in the water and his swimming and diving skills improve. Departure from the rookery of birth occurs at approximately three months of age. By the end of April, about 75 percent of the weaned pups have left the rookery (Reiter, Stinson and Le Boeuf, 1976).

Males undergo puberty at about 5 years of age but most of them do not breed until they are 8 or 9 years old or older. This is because growth continues throughout life and older bulls are larger and prevent younger males from mating. Peak reproductive success occurs at about age 10 or 11. Most males die by age 14. Females may copulate as early as age 2 (A few mate as yearlings) and give birth at age 3. Females give birth to a single pup annually at approximately the same time and in the same place until they die at about age 14.

Pup mortality prior to weaning is typically about 12 to 15 percent of pups born. But disturbance created by storms with attendant high tides and surf may multiply this figure by a factor of two or three. Most pups die as a result of a trauma-starvation syndrome. This syndrome begins with separation from the mother and is followed by starvation and injury. Separation and injuries are caused by intrasexual

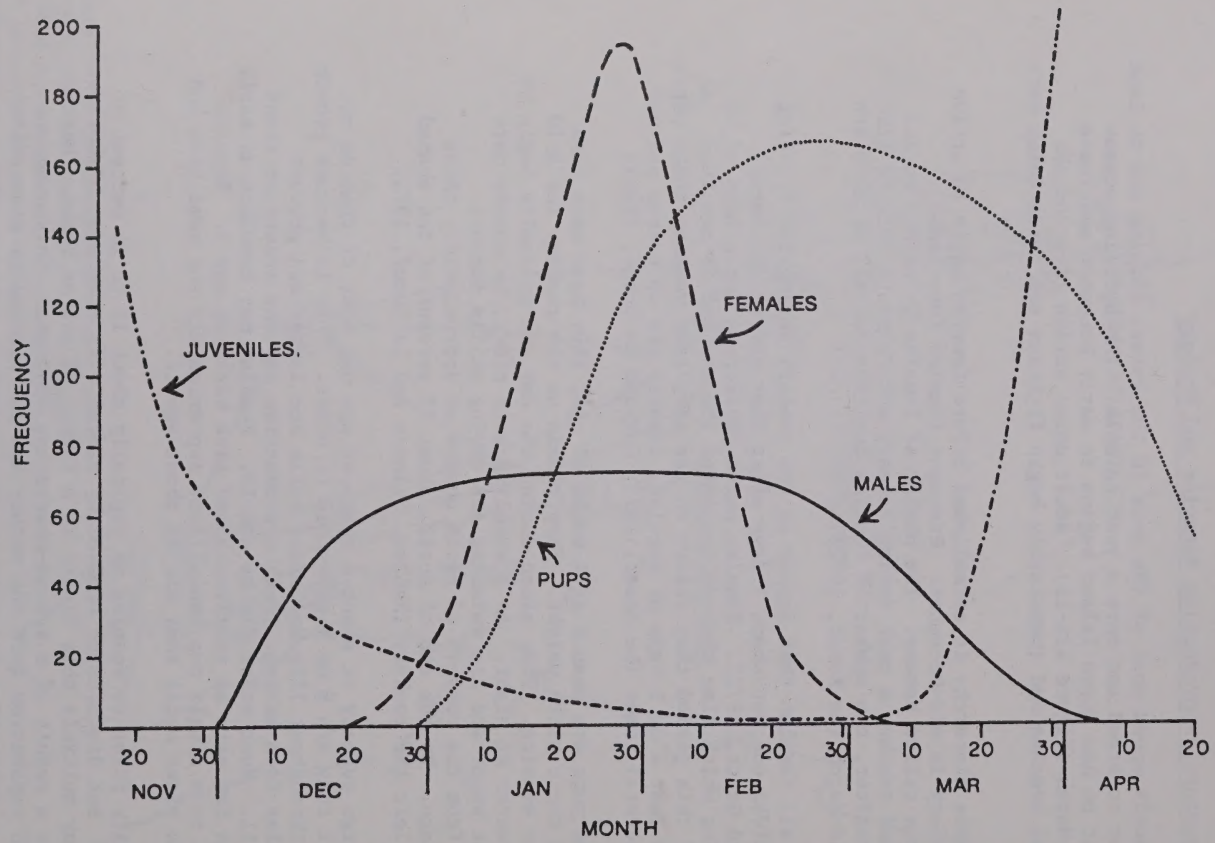


**Figure III-11** The pattern of northern elephant seal haul-out according to age and sex during the breeding season. The data shown are taken from the 1968 breeding season on Año Nuevo Island (Le Boeuf 1972). A similar pattern is found on all northern elephant seal rookeries.

competition between adult males and between adult females and is complicated by inclement weather and other disturbing agents (Le Boeuf and Briggs, 1976). Only a fraction of the males produced survive the breeding age. Mortality of males prior to reaching age 8 may range from 86 to 97 percent. Annual mortality of breeding age males range from 45 percent in pubertal age males to 50 percent in fully-grown bulls (Le Boeuf, 1974). Comparable estimates of adult female mortality are not available.

Little is known about elephant seals when they are at sea. They go to sea singly and casual observations suggest that they do not feed in groups. They feed on squid, small sharks, rays, skates, Pacific hake and ratfish (Huey, 1930; Morejohn and Baltz, 1970; Le Boeuf, unpublished data). They apparently feed nearshore and in relatively deep water, as evidenced by the fact that they have been caught in fishermen's nets at depths of 180 m (100 fathoms). Several animals have been caught in fishing nets off the southern tip of British Columbia (Le Boeuf, unpublished data).

The history of the northern elephant seal in the Bight must be considered in the context of the history of the entire population's decline and subsequent recovery. In brief, elephant seals were initially sighted in this century on San Miguel Island in the late 1930's (Bartholomew, 1951). Only sporadic observations or censuses were taken in the Channel Islands during the next two decades and these were not during the breeding season. By 1949, elephant seals were seen on San Nicolas Island and on Los Coronados, Mexico, the lower margin of the Bight (Bartholomew 1950a, 1951). The first elephant seal recorded on Santa Barbara was in 1958 (Bartholomew and Boolootian 1960). The number of seals on each island rose gradually during this period (Bartholomew and Bubbs 1960). It is not clear when breeding began on each rookery but estimates are given in Figure III-12. Clearly, each of the three rookeries in the Bight was colonized by immigrants from Isla de Guadalupe. The size of the breeding population has increased dramatically since 1960. The San Nicolas population has also increased, but more slowly. The Santa Barbara Island population has grown very slowly, due primarily to lack of breeding space.

The number and distribution of northern elephant seals in the Bight during the observation period can be described generally by considering the total number of animals censused on the island rookeries at various times during the year. Such a plot is known as the population cycle, the annual cycle, or the annual haul-out pattern of total animals. Census data are shown in Figure III-12 for three rookeries: San Miguel, San Nicolas, and Santa Barbara.

The distribution of seals on San Miguel, San Nicolas, and Santa Barbara Islands is similar (Figure III-12).

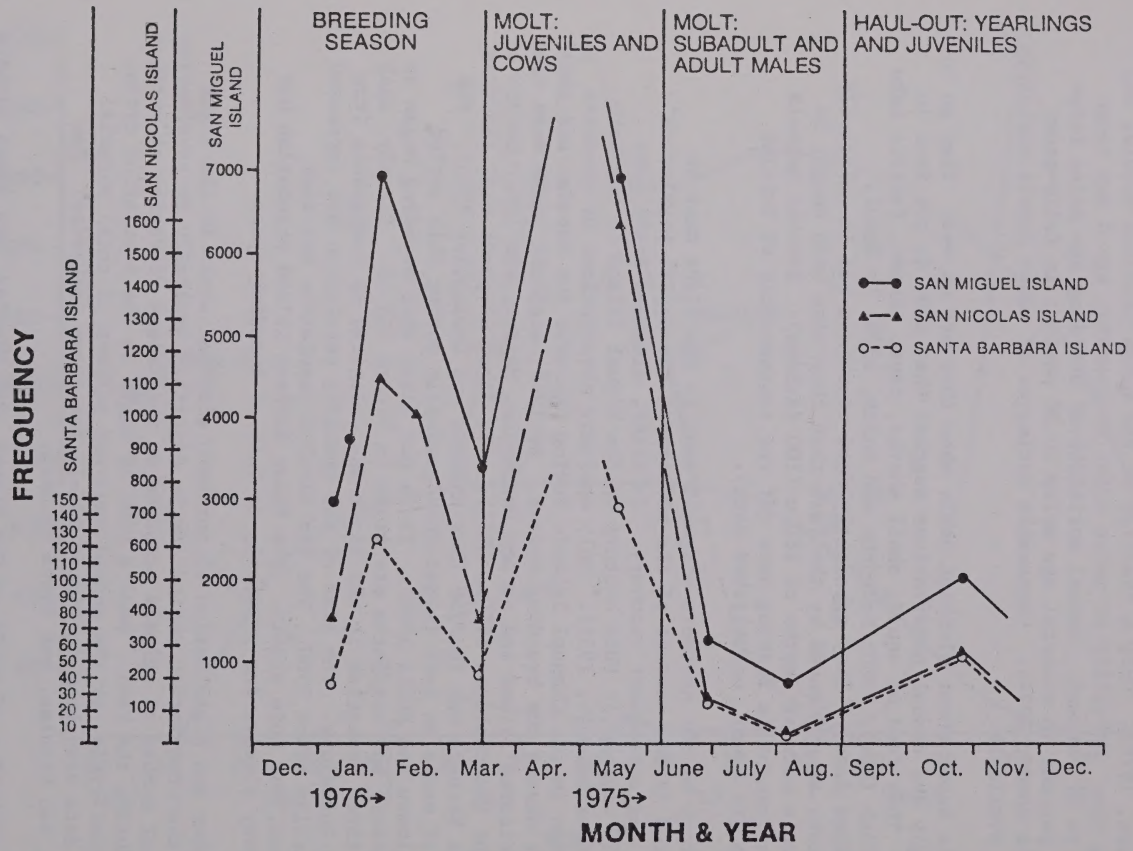


**Figure III-12** The annual cycle in total number of northern elephant seals on three rookeries in the Southern California Bight. The year is divided into four seasons. The curves are left open in the spring because we expect a peak in number to occur at that time.

Finally, the annual cycle observed on the Channel Island rookeries resembles those observed on rookeries in other parts of the range.

Thus, there appears to be ample evidence that there exists a similar annual distribution of elephant seals on each rookery in the breeding range. This is not to say that variation in distributions, even on the same rookery from year to year, does not exist.

Because within-year variance in the number of seals present is so great, consideration of the annual cycle is imperative when attempting to interpret a single census or in comparisons of censuses from one year to the next. That is, knowledge of this distribution is necessary in order to document the growth and development of a colony.

Numbers, Distribution and Seasonal Variation in Population Structure

Clearly, from the point of view of reproductive potential, San Miguel Island is once again much larger than the other rookeries in the Bight. Eighty-four percent of the females censused in late January 1976, were seen on this rookery. The relative percent of females censused on the other rookeries was: 13.5 percent on San Nicolas; 1.5 percent on Santa Barbara; and 0.01 percent on Los Coronados. A similar relationship between the rookeries is obtained if one considers the number of females or pups estimated or the highest number of living pups censused.

In general, the composition of animals with respect to sex and age seen during each season on the Channel Island rookeries, is typical of the pattern seen on other rookeries. The breeding season is notable for the presence of adult males and females, newborn pups, and the absence of juveniles. After arriving on the rookeries in December, the number of males remains fairly constant throughout the breeding season until the end of February, when they start leaving. Most males are gone by the end of March. Females begin arriving in mid-December, reach a peak in late January, and then their number declines until all of them are gone by about mid-March. Juveniles, 1½-4 years of age, begin hauling out in mid-March and their numbers inc rease to a peak sometime around late April or early May. Adult females return to the rookery to molt after a short excursion to sea following the breeding season. At least 50 percent, and perhaps up to 100 percent of the females that breed are estimated to return to molt. Most females molt on the island where they gave birth but there are exceptions. Data from Ano Nuevo Island (Reiter, et al., 1976) shows that pups born in winter begin leaving the rookeries in late February or early March; approximately 75 percent of them have departed the rookeries by the end of April. A few pups remain in the vicinity of the rookeries throughout the summer. The same situation seems to apply to the Channel Islands. The spring

period ends with a very sharp decline in the number of animals observed on the rookeries. The summer period begins with the younger males hauling out to molt. The process takes approximately 1 month to complete and that is the approximate duration of each individual's stay on land. As the summer progresses, the younger males are replaced by the mature bulls that dominated breeding the previous winter. These animals are observed in July and August, the time of year when censuses are lowest on all rookeries. The males gather in tightly packed groups, just the opposite of the manner in which they are distributed during the breeding season. The fall period is signalled by the disappearance of the molting adult bull and the arrival of juveniles and "yearlings" born the previous winter. A few yearlings molt at this time. These animals reach a peak in November or October. Their number decreases as the breeding season approaches. Immigrants from other rookeries are most frequently observed during the spring, the fall, and to a lesser extent, the breeding season (see Le Boeuf, et al., 1974). This topic will be discussed more fully in the section on movements.

Figure III-9 shows the Channel Island rookeries in relationship to other rookeries in the breeding range of the species. It is necessary to emphasize at this time that the locations of harems are traditional; the same places are used every year. Individual females return to the same location to give birth throughout their life with few exceptions (Le Boeuf, et al., 1972; H. Huber personal communication). The distribution of seals on each island rookery and hauling out area will be briefly considered taking each rookery in turn.

Most of the breeding on San Miguel Island takes place on the sandy beaches on the west end of the island (Figure III-13 and 14). This west-end area is unique in harboring such a great number of elephant seals in a single location; nearly all of the animals can be viewed from a few vantage points on the high ground to the east. An aerial photograph of this region is shown in Figure III-15. Other breeding females were aggregated on the south side of San Miguel Island (159 through 161 in Figure III-13).

As in the breeding season, the majority of elephant seals censused at all other times of the year were observed at the west end of the island.

Harems on San Nicolas Island were distributed over a 6 km (3.7 miles) segment of the southwestern side of the island (Figure III-16) Elephant seals hauled out during the non-breeding season in the same areas they used for breeding and males molting in summer showed a preference for the Elephant Seal Beach area.

Females breed in only two areas on Santa Barbara Island, a small sandy beach on the eastern side of the island and a cobbled cove with a

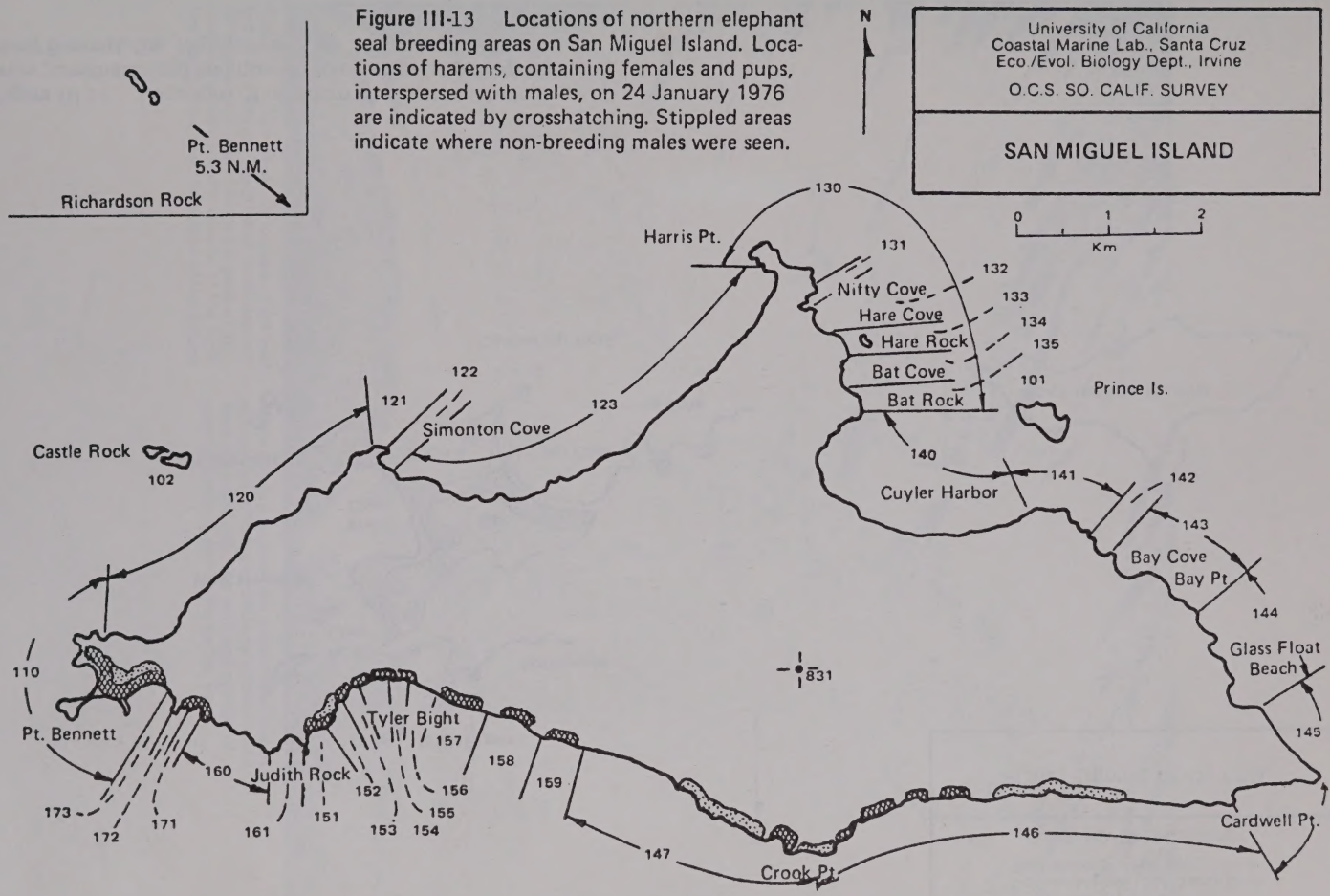


**Figure III-13** Locations of northern elephant seal breeding areas on San Miguel Island. Locations of harems, containing females and pups, interspersed with males, on 24 January 1976 are indicated by crosshatching. Stippled areas indicate where non-breeding males were seen.

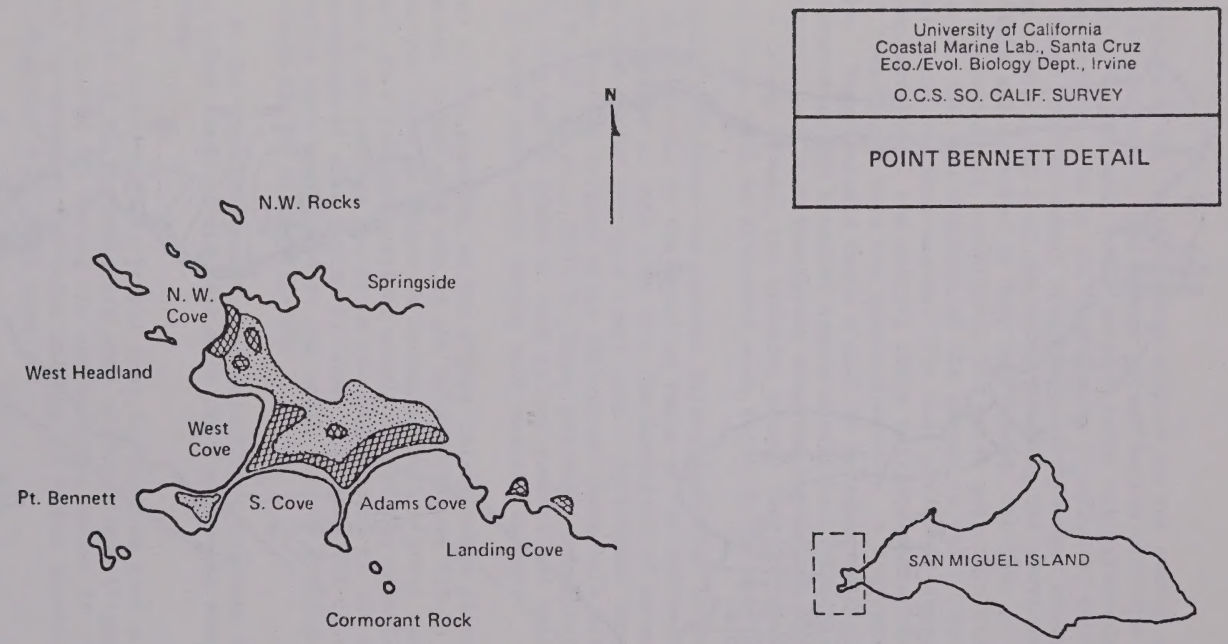


**Figure III-14** Locations of northern elephant seal breeding areas (crosshatching) and non-breeding areas (stippling) on Point Bennett, San Miguel Island, on 24 January 1976.

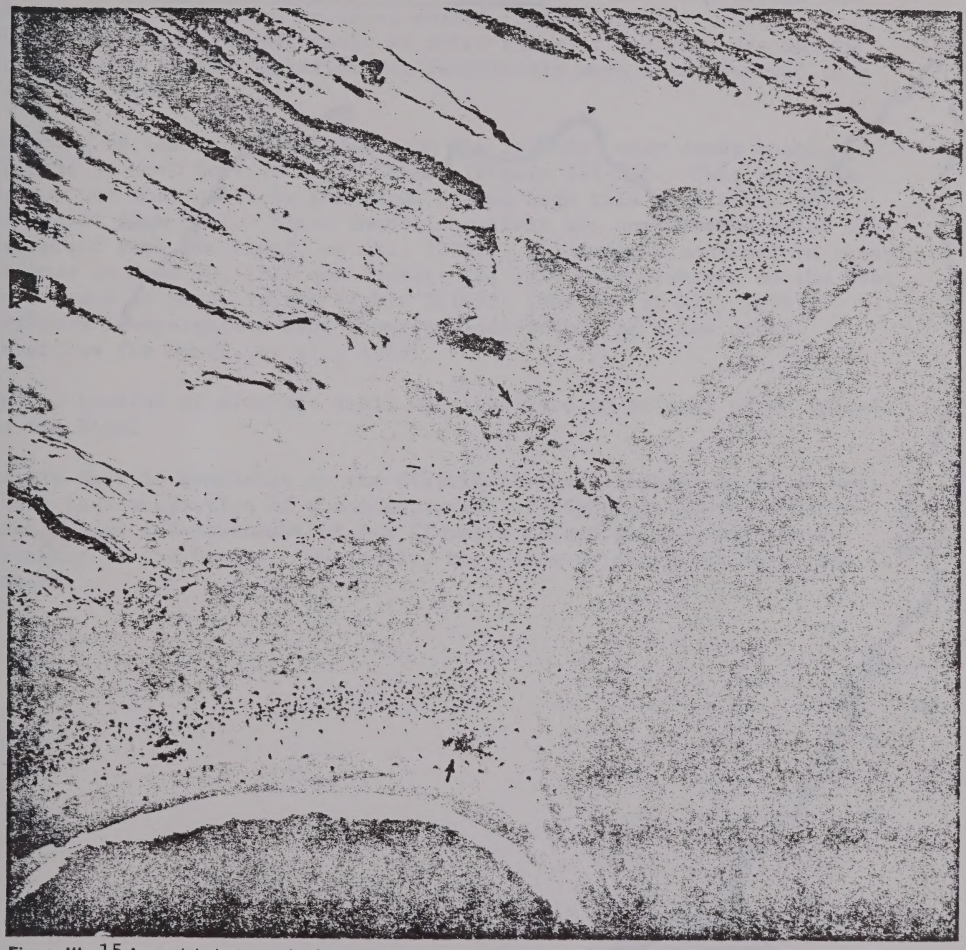

**Figure III 15** An aerial photograph of the west end of San Miguel Island taken on 20 January 1976, about one week before the peak of the breeding season. Adam's Cove is on the right and South Cove is at the bottom of the picture. There are so many animals present that harems are confluent. Note the distance of the animals from the water line. The dark aggregation of animals (arrows) are California sea lions.

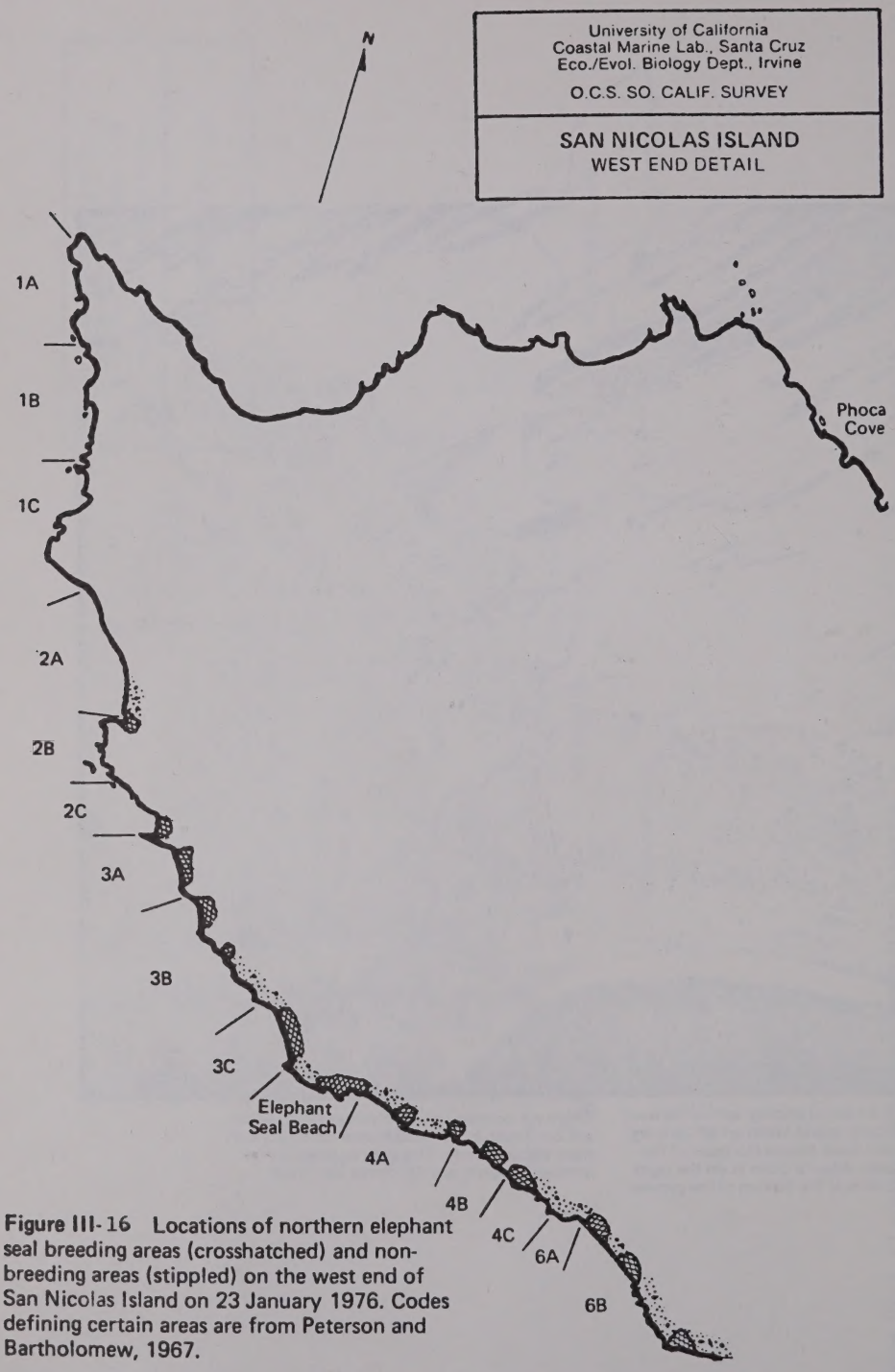


**Figure III-16** Locations of northern elephant seal breeding areas (crosshatched) and non-breeding areas (stippled) on the west end of San Nicolas Island on 23 January 1976. Codes defining certain areas are from Peterson and Bartholomew, 1967.

northern exposure (Figure III-17). These are the only locations suitable for breeding and both places can accommodate few additional females because of their small size and exposure to the sea. Young males were observed hauled out at several other locations around the small island during the breeding season (Figure III-17). The distribution of elephant seals at other times of the year was mainly concentrated on the rookeries but individuals were also observed in a few other areas.

Breeding on Los Coronados occurs on the islands' only sandy beach, located at West Cove on South Island (Figure III-18). This beach is narrow and much of it is inundated during high tide conditions with attendant high surf. These conditions limit the number of females that can breed here (Le Boeuf, et al., 1975). All animals censused on these islands on June 30, 1975 and January 22, 1976 were observed on the West Cove beach of South Island (Table III-53) (Norris, et al., 1976). Previous investigators have observed individuals at a few other locations (Le Boeuf, et al., 1975).

Only a handful of elephant seals were observed on or near other islands in the Bight.

Little data is available on the distribution of elephant seals at sea. There is a suggestion of a concentration of sightings south of Santa Rosa Island and southeast of San Clemente Island which bears close watching in the future. Obviously, more data on distribution at sea is needed.

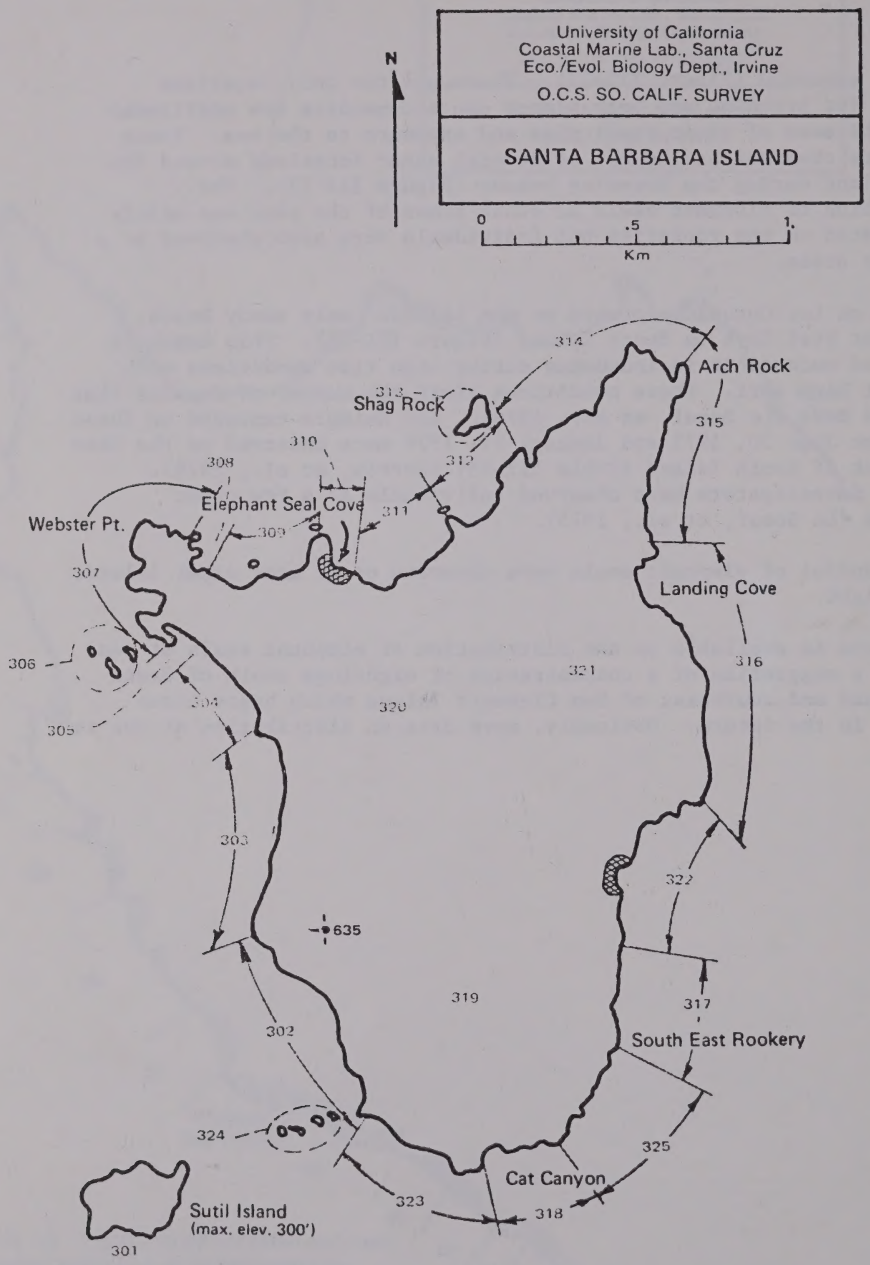


**Figure III-17** Locations of northern elephant seal breeding areas (crosshatched) on Santa Barbara Island during the 1976 breeding season.

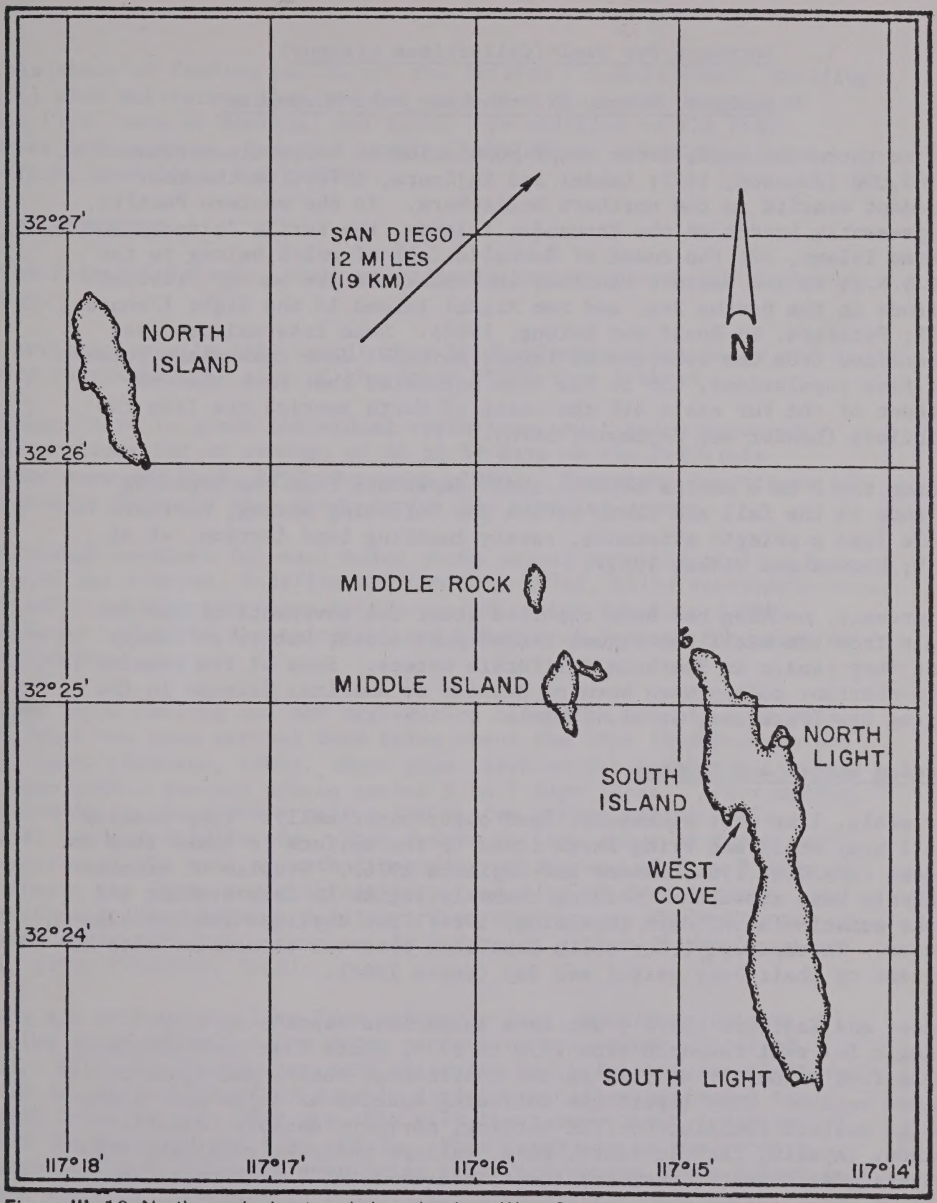


**Figure III-** 18 Northern elephant seals breed only at West Cove on South island of Los Coronados.

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## 3. Northern Fur Seal (Callorhinus ursinus)

### Numbers, Range, Distribution, and Movements

The northern fur seal, whose total population is currently estimated at 1,765,000 (Johnson, 1975; Lander and Kajimura, 1976), is the most abundant otariid in the northern hemisphere. In the western Pacific, it presently breeds on the Commander Islands, the Kurile Islands, and Robben Island, off the coast of Sakhalin (all of which belong to the U.S.S.R.); in the eastern Pacific, the rookeries are on the Pribilof Islands in the Bering Sea, and San Miguel Island in the Bight (Johnson, 1975; Peterson, Le Boeuf and DeLong, 1968). Some intermxiture (as determined from the recovery of tagged animals) does take place between the five populations, but it has been estimated that more than 96 percent of the fur seals off the coast of North America are from the Pribilofs (Lander and Kajimura, 1976).

During the 5 to 8 months between their departure from the breeding islands in the fall and their return the following spring, northern fur seals lead a pelagic existence, rarely touching land (Jordan, et al., 1899; Kenyon and Wilke, 1953).

At present, nothing has been reported about the movements of the fur seals from the small San Miguel Island population, but it is likely that they remain in Southern California waters. Some of the females in this aberrant colony were born on Russian or American islands in the Bering Sea (Peterson, et al, 1968c).

### Feeding Habits and Ecology

Fur seals, like most pinnepeds, feed opportunistically. They swallow small prey whole and bring large items to the surface to shake them to pieces (Spalding 1964; Lander and Kajimura 1976). Studies of stomach contents have shown that feeding commonly begins in late evening and peaks sometime after dark (Spalding, 1964), but daylight feeding also occurs. In captivity, fur seals have been observed to consume 6 to 10 percent of their body weight per day (Keyes 1968).

Lander and Kajimura (1976), who have summarized reports on U.S. pelagic fur seal research from 1958 to 1974, state that northern fur seals feed primarily on fish on the continental shelf, and squid in deeper waters. They report the following species as major prey items in the eastern Pacific; Pacific herring, northern anchovy, Pacific salmon, capelin, Pacific saury, hake, walleye pollock, rockfish, Atka mackerel, sand lance, deep-sea smelt, and at least 9 species of squid (all of which except one, Loligo opalescens, are considered deep-water species). Of these, anchovy, saury, hake, and squid are the predominant prey in California waters.

In his study of feeding habits off the British Columbia coast, Spalding (1964) also determined that the fur seal diet consisted largely of small fish, such as herring, and squid. In addition to the prey species listed above, he noted lamprey, sablefish, stickleback, cod, flatfish, greenling, and ratfish.

Social Structure

On the Pribilof Islands, early males begin hauling out on the rookeries in May.

New arrivals usually gain territories by displacing other males and slowly increasing the size of the areas which they control.

Although there is great individual variation, adult males apparently hold territory for an average of 40 to 50 days on the Pribilofs (Bartholomew and Hoel, 1953; Peterson, 1965). Temporary desertions of territories by bulls also occur during the breeding season.

Even though northern fur seal males reach sexual maturity at 5 or 6 years of age (Kenyon, Scheffer and Chapman, 1954), bulls apparently have difficulty holding territory before age 10, which Scheffer (1950) considered to be the physiological and behavioral "prime" for males of this species.

Females begin hauling out and aggregating along the shoreline in late June, with the mean arrival date being about the 30th (Bartholomew and Hoel, 1953; Peterson, 1965). Most give birth within 3 days of landing and come into a one-day estrus period 5 to 7 days later. After mating, they remain on the rookery only a day or two before making their initial feeding trip to sea. They return to land about 10 times over the course of the next 4 months, spending an average of 5 to 8 days at sea during the first and shortest trip, and 8 to 10 days during subsequent trips. Between feeding trips, they are on the rookery nursing their pups for approximately 2 days at a time (Bartholomew and Hoel, 1953; Peterson, 1965).

Births are centered in late June and early July, when females are arriving en masse, but a few occur as late as mid-August (Peterson, 1965). Although females are very attentive to their pups for the first day or so, their solicitude quickly diminishes; after beginning their feeding trips to sea, they are only with their pups about 1 day out of 4 or 5 (Bartholomew and Hoel, 1953). Upon returning to the rookery, females haul out and begin vocalizing, thus attracting every hungry pup in the vicinity. They sniff at each approaching pup until they recognize their own and reject the advances of alien pups (Bartholomew, 1959; Peterson, 1965).

When born, pups weigh 4.5 to 5.5 kg (10-12 pounds) and are covered with a thin, black natal pelage (Baker, et al., 1970). They are fairly well coordinated at birth, and are capable of swimming clumsily on their first day. Independent practically from the beginning, pups congregate in groups while their mothers are at sea. They usually gather inland of the main breeding aggregations. They develop rapidly, and are wandering freely about the rookery by 3 or 4 weeks of age. In late July, they begin entering shallow tide pools and, by August, they are swimming 10 to 15 m from shore (Bartholomew, 1959).

In contrast to the other species of otarilids found on the coast of North America (see species accounts for the Steller and California sea lions and the Guadalupe fur seal in this report), northern fur seal pups are weaned abruptly at about 4 months of age. In early November, when the females begin their long migration south, pups are abandoned and forced to fend for themselves during their first winter at sea. Mortality is, in fact, about 50 percent during the first year, and approximately 70 percent of a given year class is lost by age 3 (Kenyon and Wilke, 1953; Chapman, 1964).

Population Size and Trends

The mass destruction of pinnepeds along the Pacific coast by sealers during the last century has obscured the history of the northern fur seal in the Bight (Scammon, 1874; Starks, 1922; Repenning, et al., 1971).

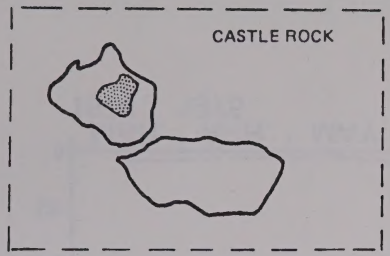
The north Pacific populations were also heavily cropped by commercial sealers in the nineteenth century.

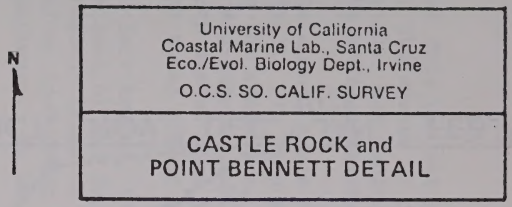
In July 1968, biologists from the University of California at Santa Cruz discovered a breeding aggregation of approximately 100 northern fur seals on Adams Cove, at the western tip of San Miguel Island (Peterson and Le Boeuf, 1968; Peterson, et al., 1968c).

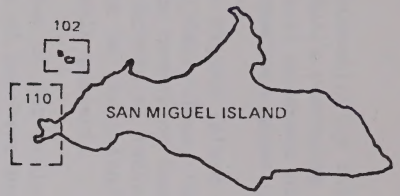
The breeding population has grown since its discovery. From 1969 to 1973, the number of pups born each season rose from 28 to more than 261. During that time, the number of females present on San Miguel in the summer increased from 180 to 274 (Johnson, 1975). More recently, the San Miguel population has been estimated at about 2,000 animals (Lander and Kajimura, 1976).

Annual Cycle and Pattern of Haul-out

Fur seals presently utilize two areas on San Miguel Island as rookeries -- Adams Cove, on Point Bennett, and Castle Rock, located off the northwest side of the island (Figure III-19). The Adams Cove group is slightly smaller than the Castle Rock group (Figure III-20). It is likely that a certain amount of intermixture of the two groups occurs,



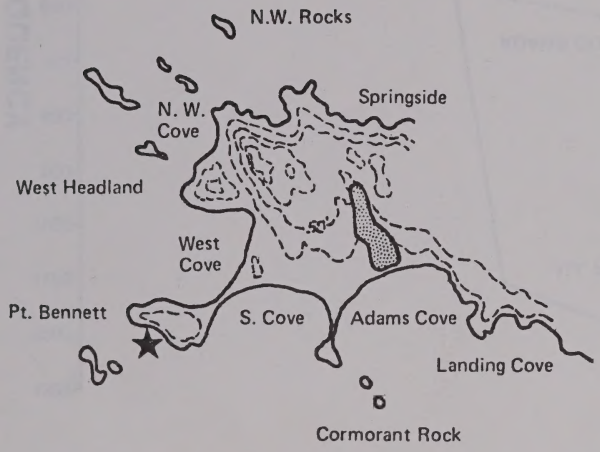




**Figure III-** 19. Location of northern fur seal rookeries on Castle Rock and Adams Cove, San Miguel Island. Star indicates location of Guadalupe fur seal on 27 June 1975.

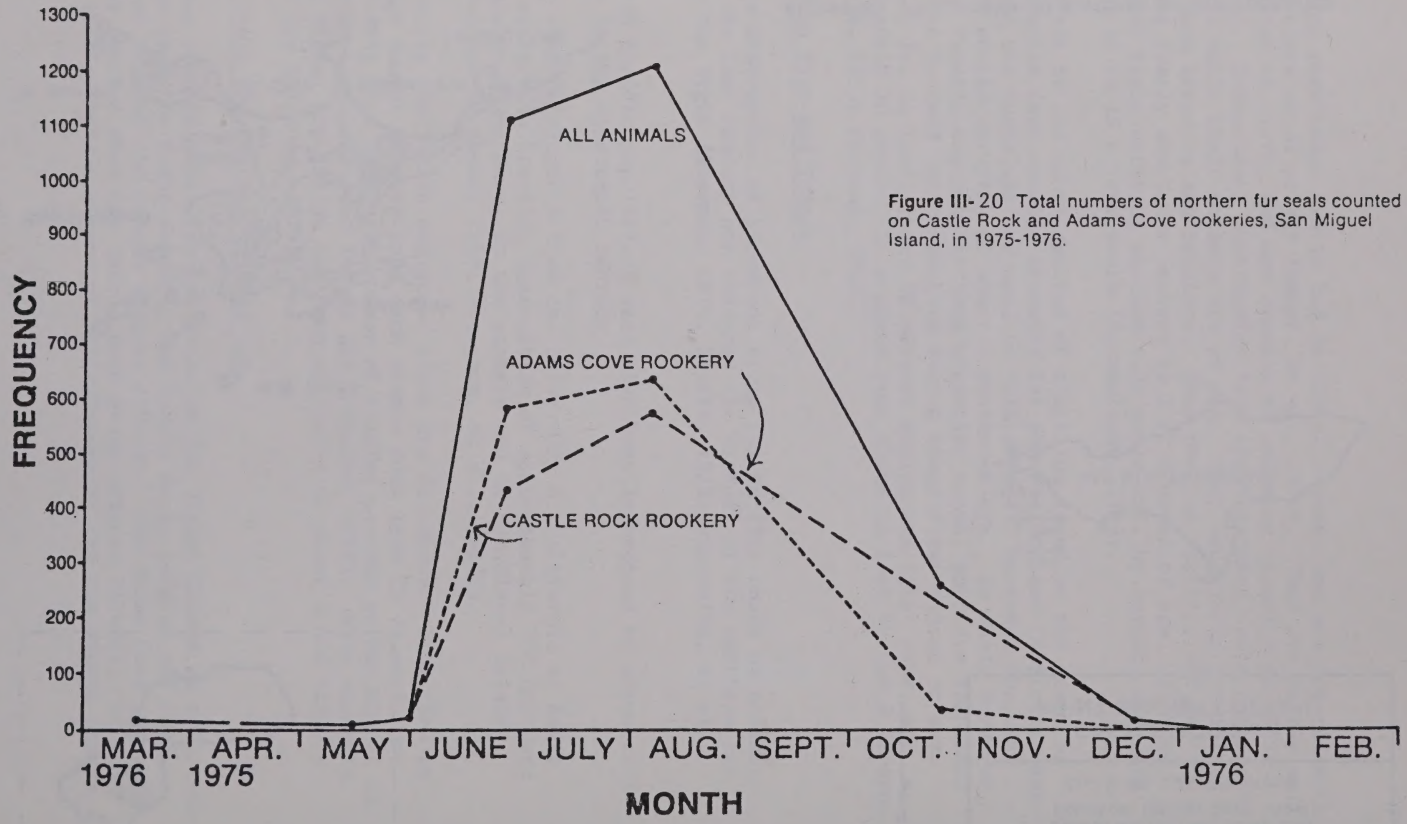



**Figure III-20** Total numbers of northern fur seals counted on Castle Rock and Adams Cove rookeries, San Miguel Island, in 1975-1976.

but this has not been documented by this study. The more rapid decline in the number of individuals remaining on Castle Rock in September and October may indicate a fall movement of females and pups from there to the more sheltered and spacious Adams Cove area.

The annual cycle for San Miguel Island as a whole is shown in Figure III-21. In late May and early June, the first pregnant females arrive on the rookeries, and the number of females and pups begins to rise to a mid-August peak. Non-breeders, including yearlings and juveniles of both sexes, also haul out on the island during this period, adding to the total number of animals present.

In late August, the number of fur seals begins to decline, presumably because of the departure of non-breeders and the nursing females' frequent trips to feed at sea. As females and their pups leave the island in October and November, independent of each other, the decline continues. In December, few or no fur seals remain on the island.

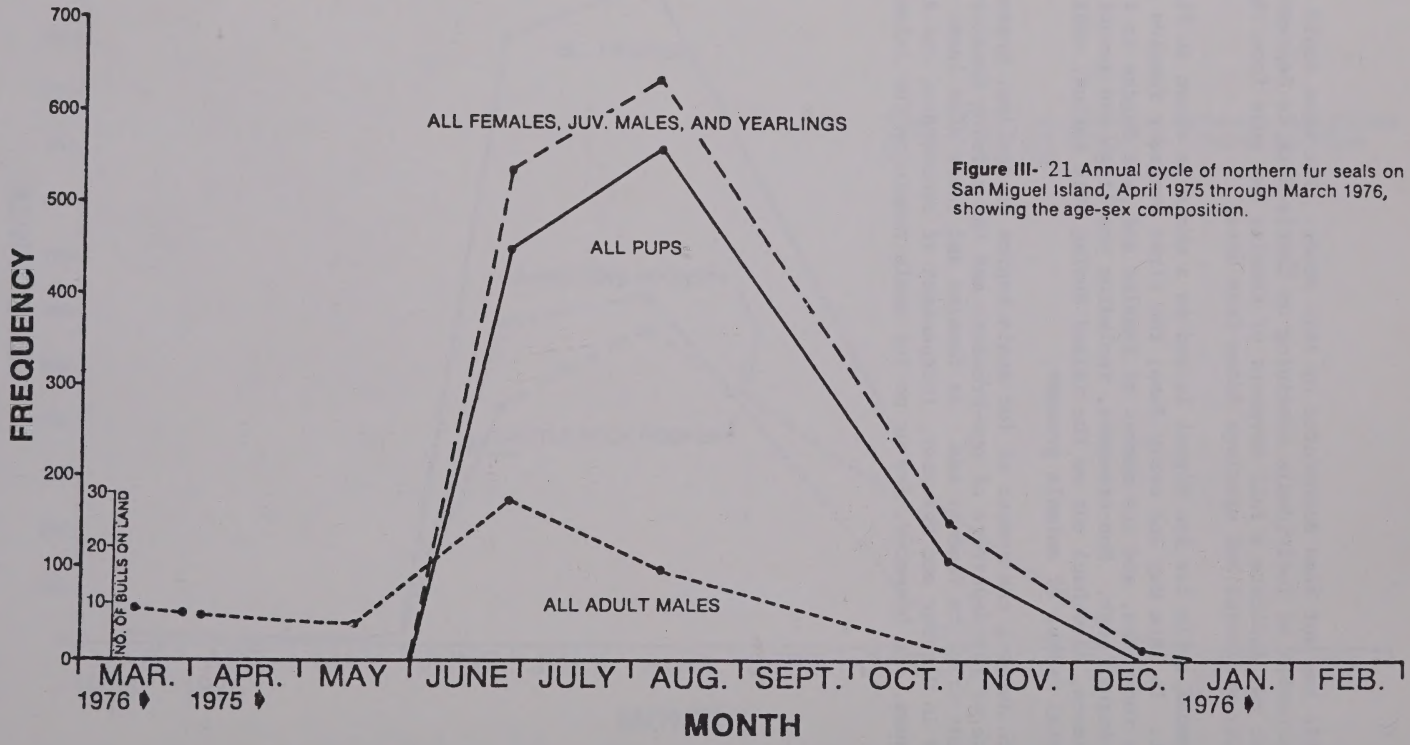



**Figure III-** 21 Annual cycle of northern fur seals on San Miguel Island, April 1975 through March 1976, showing the age-sex composition.

On a smaller scale, the number of adult males present on San Miguel also increases in May, reaching a high point in late June and decreasing thereafter, as the territories disintegrate. Although observations of adult males on the island outside of the breeding season have been spotty, a few have been seen in March.

Because of the problems involved in differentiating non-territorial from territorial males and breeding females from non-breeders, it is difficult to obtain an accurate male to female ratio from aerial photographs. Nevertheless, a rough ratio of approximately one male for each 18 females was calculated from a June survey (Norris, et al., 1976). This is quite low compared to those observed on the Pribilof Island rookeries (Bartholomew and Hoel, 1953; Peterson, 1965), but somewhat higher than the male-female ratios observed on San Miguel Island during previous breeding seasons (DeLong, 1975). DeLong (1975) suggested that the scarcity of males in the San Miguel breeding population indicates little or no recruitment from Bering Sea populations. If this is the case, there should be an increase in the relative abundance of males as the colony continues to grow and more local born males reach sexual maturity.

Three age and sex categories could be discerned in census photographs of the San Miguel Island fur seal colony: pups of the year, nursing females combined with non-breeding animals, and males.

Peak pup counts occur in August. From census photographs, 559 pups were counted on the two rookeries combined. This census took place about 2 weeks after the pup population reached its maximum. By fitting a curve to the pup counts, a total pup production of at least 600 animals was determined (Figure III-22).

The number of breeding females in a population can be best estimated from the number of pups. For the 1975 season on San Miguel Island, the breeding females probably totaled about 600, less than half of which were on land at any given time. Using a statistical model, nursing females were calculated to account for 26 percent of the total animals, 46 percent of the total adults, and 48 percent of the combined female/non-breeder category present during the month of June. By August the nursing females were calculated to represent 10 percent of the total animals, 18 percent of the total adults, and 19 percent of the combined female/non-breeder category.

From the statistical model of Bartholomew and Hoel (1953), the number of non-breeders can be calculated by subtracting nursing females from the count of females plus non-breeders. The non-breeding population is shown in Figure III-22.

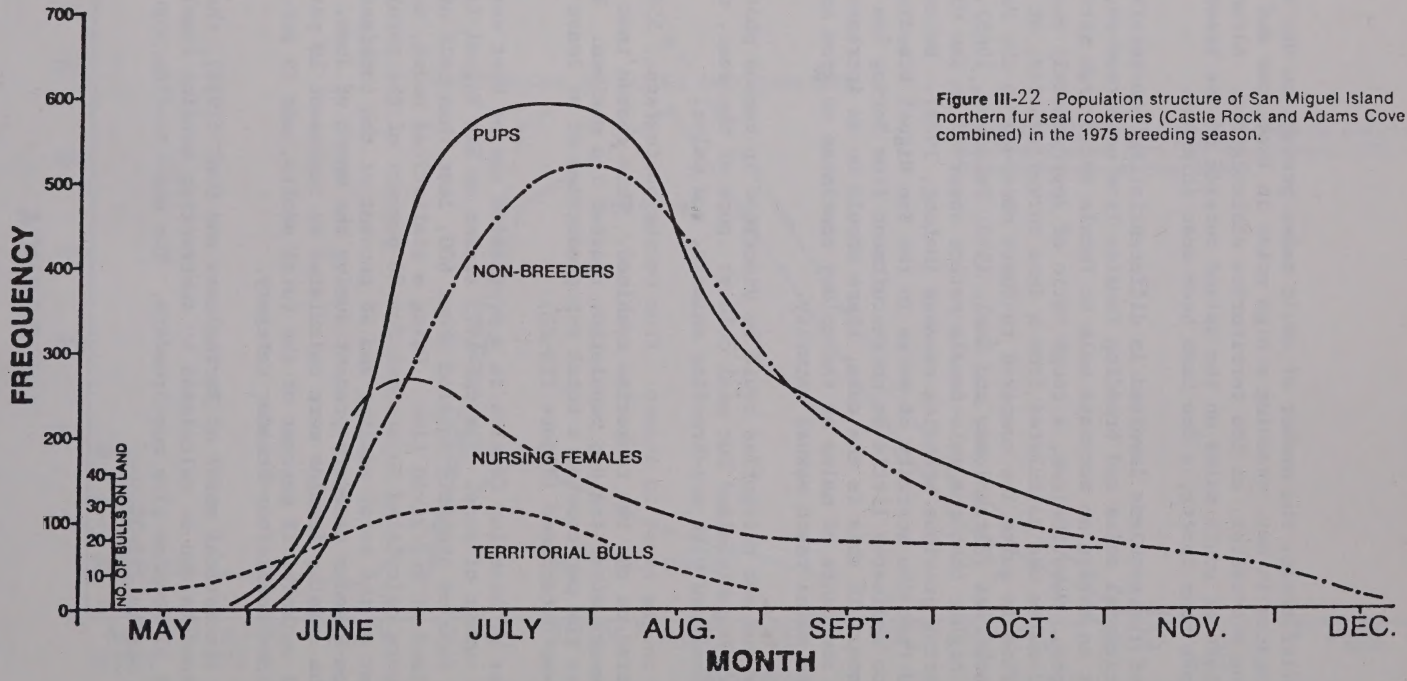



**Figure III-22** . Population structure of San Miguel Island northern fur seal rookeries (Castle Rock and Adams Cove combined) in the 1975 breeding season.

Territorial bulls and peripheral males numbered 39 in June 1975 and represented 4 percent of the total population. These males made up less than 7 percent of the total estimated breeding female population (600). Peterson (1965) found the number of bulls to be about 10 percent of the females in the Pribilof Islands. By August, the number of territorial bulls and peripheral males dropped to 17 and represented only 1.4 percent of the total population counted.

In August 1975, 1,210 animals were counted on land and an additional 480 adult females were calculated at sea. A component of the non-breeder category may also have been at sea, but no data is available to indicate how many. A minimum estimate of the size of the San Miguel Island population at the present is 1,700 animals.

Earlier pelagic investigations conducted by the U. S. Bureau of Commercial Fisheries have found northern fur seals to be quite common in the waters off Southern California in the winter and spring months (January to June). Although the greatest numbers have been observed along the continental shelf, from 37 to 130 km (23.0-80.7 miles) off the coast (Fiscus and Kajimura, 1969), fur seals have also been seen in smaller numbers, near all the islands in the Bight, off Point Loma (near San Diego), and so far south as latitude 30¼N (Taylor, et al., 1955; Fiscus and Kajimura, 1969).

All of the animals seen at sea in recent years, were adult females or juveniles of either sex (Norris, et al., 1976). Considering the small size of the sample, it is not surprising that no adult male fur seals were spotted at sea; less than 2 percent of the 436 northern fur seals collected by the U. S. Bureau of Commercial Fisheries off California in 1966 were males (Fiscus and Kajimura, 1969). As the San Miguel Island population continues to grow, sightings of males at sea will probably become more common.

4. Harbor Seal (Phoca vituliwa)

Range, Distribution, and Movements

The harbor seal ranges from Herschel Island (69¼ 35'N, 139¼W) and Point Barrow, Alaska, south along the coasts of British Columbia, the United States and northern Mexico. Pups have been seen as far south as Isla San Martin (30¼30'N,116¼06'W), off Baja California, Mexico (Bonnell and Pierson, 1970). Scheffer (1958) points out that their southern range is probably limited to the latitude of Isla Cedros (28¼12'N) by a rise in water temperature.

Coastal in distribution, harbor seals are believed to be relatively sedentary, forming small stable local populations. Some intermixing, however, certainly takes place.

Occasionally seen around harbors, breakwaters and jettys, harbor seals usually avoid man's activities. With few exceptions they also avoid beaches occupied by other pinnipeds and haul out generally on the most secluded beaches, rocks and mud flats where they form loose aggregations. These "herds" show no obvious social structure. Individual spacing, however, creates a dramatic pattern, especially on beaches where all animals are oriented toward the water.

No annual migrations are apparent. However, small-scale local movements are common and probably represent a response to an increase or a decrease in a food resource or human activity. Movement of harbor seals into estuaries and up rivers has been reported in British Columbia, Washington, and Northern California (Fisher, 1952; Scheffer and Slipp, 1944; and Paulbitski, 1974).

Food Habits and Ecology

The harbor seal has a fish diet. A wide variety of fish and mollusks have been found in stomach samples (Scheffer and Slipp, 1944; Spalding, 1964). The harbor seal feeds in inshore waters where it is opportunistic in its choice of food. Small fish (e.g., eulachon, hake, and herring) were found to be the most common stomach contents for harbor seals collected in British Columbia waters during the winter, spring and summer months; salmon accounted for one-third of the stomach contents in the fall (Spalding, 1964).

When several food types are abundant the harbor seal feeds selectively with definite food preferences. Kenyon (1965) found octopus and mackerel exclusively in stomachs of 11 harbor seals collected in Alaska; only one seal had fed on both types of food. The quantity and freshness of food in the stomachs of animals collected in the later afternoon indicated a daytime feeding habit. Mean stomach contents of 50 harbor seals collected in British Columbia also were at a maximum in late afternoon (Spalding, 1964). Fishermen's accounts indicate that Washington harbor seals steal fish from nets at all hours (Scheffer and Slipp, 1944).

Social Structure and Reproductive Behavior

Harbor seal females give birth to single pups in the spring or summer. Bigg (1969a) has collected evidence of latitudinal clines in the onset of the pupping season. Pupping tends to occur progressively later as one goes southeast from Alaska to Puget Sound, yet occurs progressively earlier as one goes south along the coast of Washington, Oregon, California, and Mexico. On Ano Nuevo Island, California, pups are seen from late April through May (Gentry, 1968; Le Boeuf, unpublished data). Bartholomew and Boolootian (1960) counted pups on San Miguel and Santa Rosa Islands in mid-February.

Pupping generally occurs on land; however, there exists circumstantial evidence for aquatic births in Great Britain (Venables and Venables, 1955). The precocious pups are able to swim and dive almost immediately following birth. Kinkhart (1967) witnessed a pup and its mother swim away together 18 minutes after delivery. Nursing lasts 4 to 6 weeks (Finch, 1966; Bigg, 1969b; Newby, 1973a). Females with pups may form aggregations separate from the main herd (Newby, 1973a).

After weaning, the pups are on their own and presumably learn to feed themselves without help or example from adults. In the Bight the pupping season lasts at least 2 months. The breeding season begins shortly after the weaning of pups and lasts for about 1 month. However, some mating has been observed to take place prior to the whelping of pups in Shetland, Great Britain (Venables and Venables, 1959). Spermatogenesis in males is found from March through November in British Columbia (Bigg, 1969b). Harbor seals usually mate in the water but mating may occur on land at night when the animals are safe from disturbance.

Harbor seals are considered to be promiscuous during the breeding season; however, some competition among males for females or space probably occurs. Fighting has been described anecdotally and wounds and scars are seen frequently on the necks of males (Scheffer and Slipp, 1944; Gantt, et al., 1961). The larger size of male harbor seals relative to females is additional evidence of male-male competition during the breeding season. Therefore, some degree of polygamy in this species is suspected.

In addition to competition, the advantage of large body size and large fat store, for animals that fast during the breeding season, has been pointed out by Bartholomew (1971). Spalding (1964) found food in only 5 of 45 stomachs collected in British Columbia at the peak of the breeding season.

Population Size

In 1958, Scheffer estimated the total population of P. v. richardi along the western seaboard of North America at 20,000 to 500,000 animals. The California population is estimated to be at least 2,000 animals (Carlisle and Alpin, 1971).

The Mexican populations (referred to also as P. v. geronimensis) have never been adequately censused. Harbor seals are known to haul out in substantial numbers at two locations: Los Coronados (15 km (9.3 miles) offshore of Baja California just south of the international boundary) and Isla San Martin (30¼30'N latitude). It is reasonable to assume that harbor seals are to be found between these two locations. South of Isla San Martin, harbor seals are extremely rare; in two spring

visits to Isla de Guadalupe, Islas San Benito and Isla Cedros, only one animal was seen.

Annual Cycle and Pattern of Haul-out

The most obvious feature of the harbor seal's annual cycle was a 4-fold increase in numbers on land in the spring (see Figure III-23). This dramatic increase was followed by a seemingly abrupt decline to winter levels in the summer and early fall. This pattern was also evident in data collected on Ano Nuevo Island, 420 km (260.8 miles) to the north. However, on the latter island the peak counts were in July rather than May.

Pupping and Breeding Season

The birth of pups contribute to the spring increase in numbers. The first pups of the year are seen in March. Pup counts during 1975-1976 ranged from 6 percent of the San Miguel and Santa Rosa Islands population in March (1976) to 15 percent of the Santa Catalina Island population in May (1975). These counts, though few and far between, are consistent with estimates for well-studied populations: pups accounted for 18 percent of the total population on Sable Island, Nova Scotia (Boulva, 1971), 18 percent in Shetland, Great Britain (Venables and Venables, 1955) and 20 percent in British Columbia (Bigg, 1969b).

Figure III-24 shows locations within the Bight where pups were seen. The islands of San Miguel, Santa Rosa, Santa Cruz, San Nicolas, Santa Barbara and Santa Catalina are locations known to have been used by harbor seals for pupping. San Clemente Island was probably also used for pupping. Unlike the California sea lion, the northern fur seal, and the northern elephant seal, harbor seals do not congregate conspicuously in a few restricted locations during the breeding season. Rather, the massing of adults and the birth of pups takes place in most of the areas where harbor seals are usually found. During the breeding season, the numbers hauled out in these scattered locations increased dramatically. Pups were seen from location to location but without a uniform pattern. In some locations, many pups were seen, presumably associated with nearby females. In other locations, only adults were seen.

Pups are easily distinguishable only in the spring. By summer few, if any, newborns are present, and 2- or 3-month-old animals are quite large.

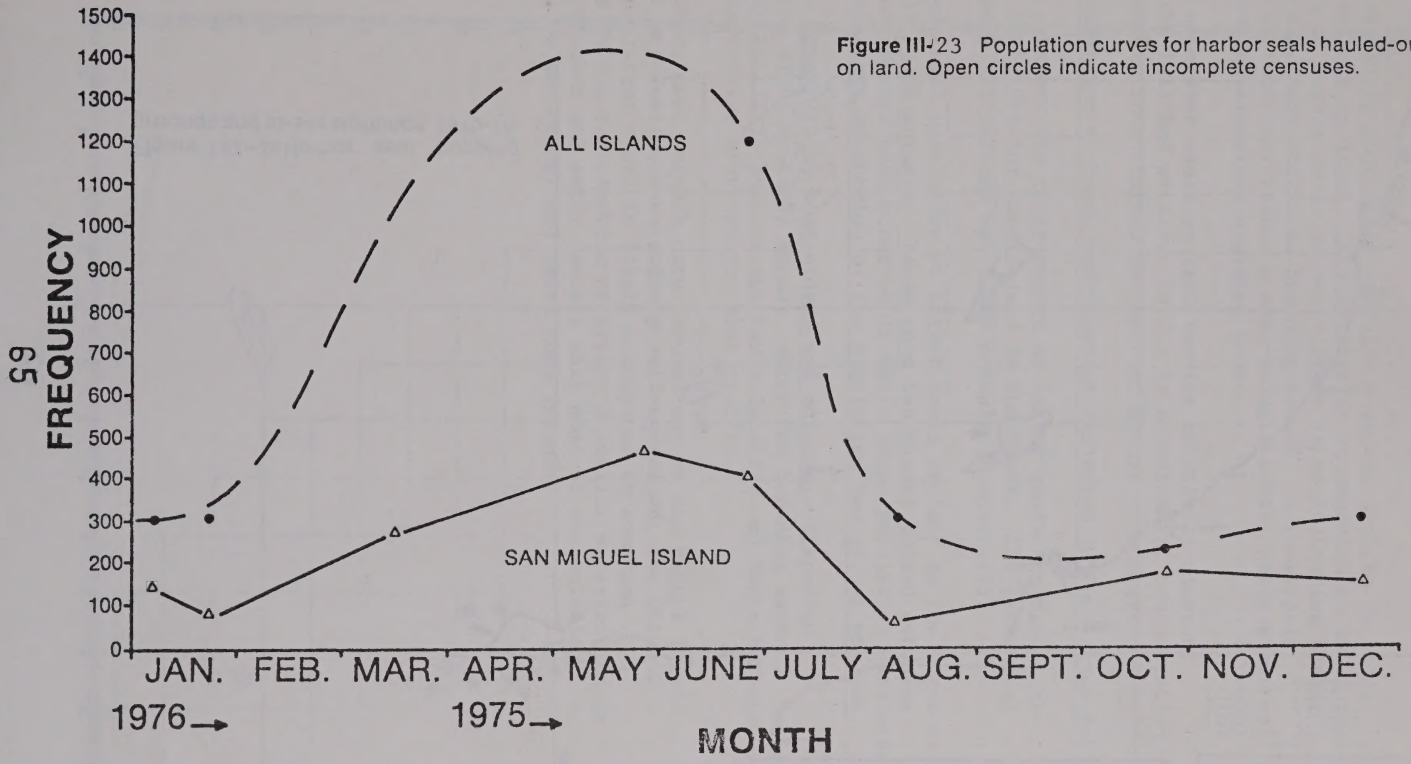



**Figure III-23** Population curves for harbor seals hauled-out on land. Open circles indicate incomplete censuses.

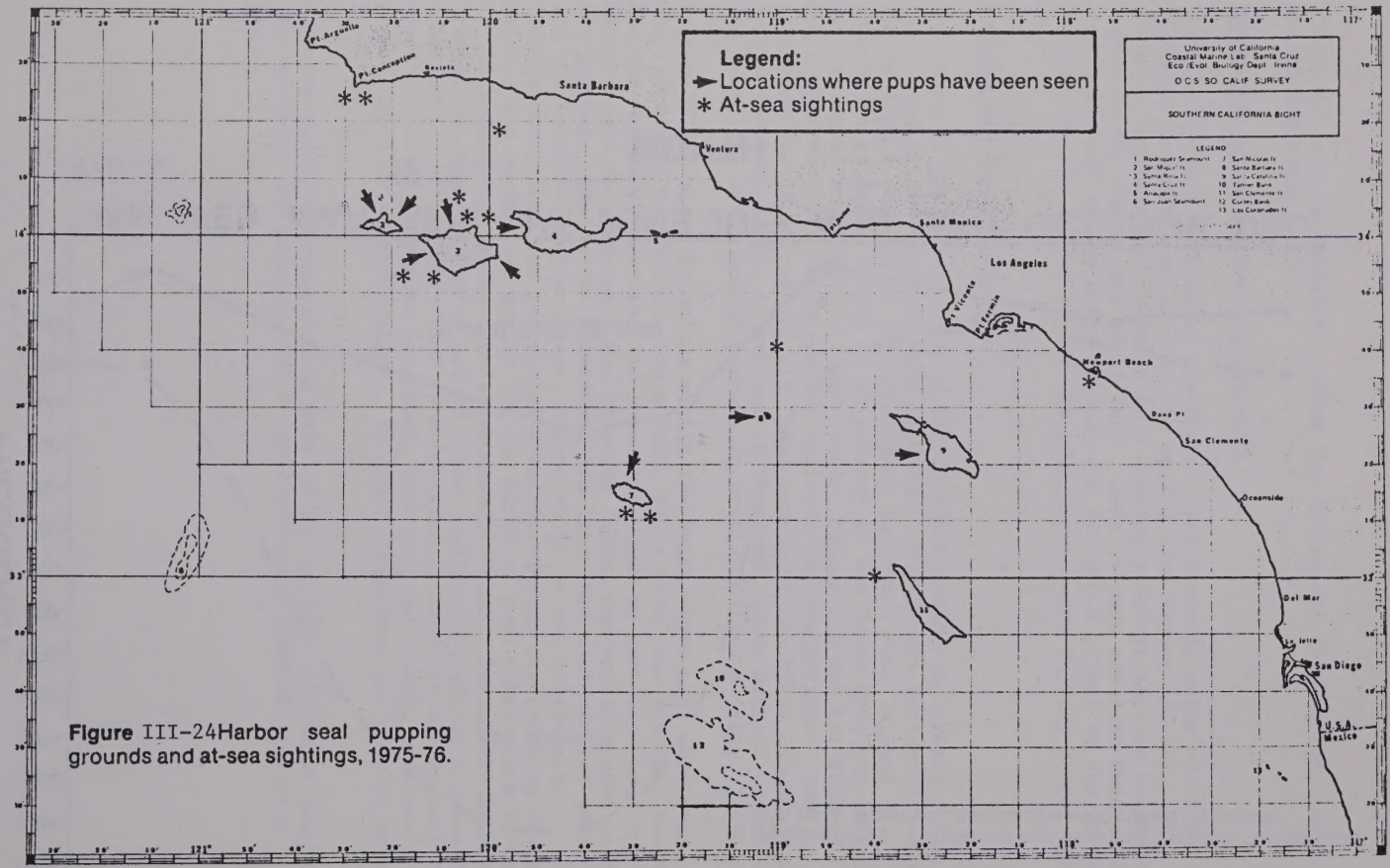



**Figure** III–24Harbor seal pupping grounds and at-sea sightings, 1975-76.

By August, the Bight population exhibits a sudden decline in total numbers of animals on land. This decline is accompanied by an increase in sightings of harbor seals at sea. There is no indication harbor seals leave the Bight after the breeding season. A reasonable explanation is that they resume a semi-pelagic habit, hauling out on land less frequently during daylight hours.

The numbers of harbor seals on land remains relatively constant throughout the fall and winter. Shifts in locations of concentration suggest extensive inter-island movement of groups of animals.

Numbers, Distributon on Land, and Seasonal Variation in Population Structure

Table III-3 presents the total counts of harbor seals throughout the survey year 1975-1976 for each island in the Bight. The peak total count combining all islands was 1,190 animals in June 1975.

The projected total population of harbor seals on land in the Bight is approximately 1,400 animals. Based on a San Miguel Island censuses, the peak count should have occurred in May. These population estimates represent only that proportion of the population hauled out on land.

Harbor seals appear to be most widely and uniformly dispersed throughout the Bight by early August, after the breeding season. Small numbers occur on all islands except Santa Catalina and Santa Barbara. These islands receive heavy summer boat traffic.

In late October, most animals occur hauled out on San Miguel Island. If the Bight population is relatively self-contained, the October relocation of harbor seals is likely a response to seasonal fluctuations in the distribution of prey. A similar distribution is evident in December and early January with most of the animals concentrated on San Miguel and Santa Rosa Islands.

Table III-3 Census of harbor seals on the islands of the Southern California Bight 1975-1976 survey year. Numbers in parentheses are incomplete counts. nc = not censused.

| | 16-17 May 1975 | 27-30 June 1975 | 4-7 Aug 1975 | 23-26 Oct 1975 | 16-18 Dec 1975 | 6 Jan 1976 | 22-25 Jan 1976 | 13-15 Mar 1976 |
|---|---|---|---|---|---|---|---|---|
| San Miguel Is. | (464)[1] | 400 | 52 | 176 | nc | 146 | 89 | 265 |
| Santa Rosa Is. | (136) | 336 | 82 | | 107 | nc | 124 | 353 |
| Santa Cruz Is. | (1) | 195 | 50 | 30 | nc | nc | 66 | (20) |
| Anacapa Is. | (1) | | 18 | | nc | nc | | nc |
| San Nicolas Is. | | 255 | 36 | 20 | nc | 27 | 28 | 128 |
| Santa Barbara Is. | | 4 | | | | nc | | |
| Santa Catalina Is. | 152 | | | | nc | nc | | 150 |
| San Clemente Is. | 38 | | 64 | | 26 | nc | | |
| TOTAL | (792) | 1190 | 302 | 226 | | (306) | 307 | (916) |

[1] Partial census of San Miguel Is. on 17 May 1975 was supplemented with counts of missed beaches made on 30 May 1975.

Harbor seals, like most pinnipeds, are highly selective in their choice of hauling grounds. Furthermore, among these preferred locations only a few are apparently acceptable as pupping grounds.

The hauling grounds on San Miguel Island are shown in Figure III-25. All harbor seals seen on San Miguel Island haul out on sand beaches. Specific beaches are consistently used as hauling grounds.

Pups are seen in March and May at most of the commonly used hauling grounds. Figure III-25 shows the locations on San Miguel Island where pups were seen.

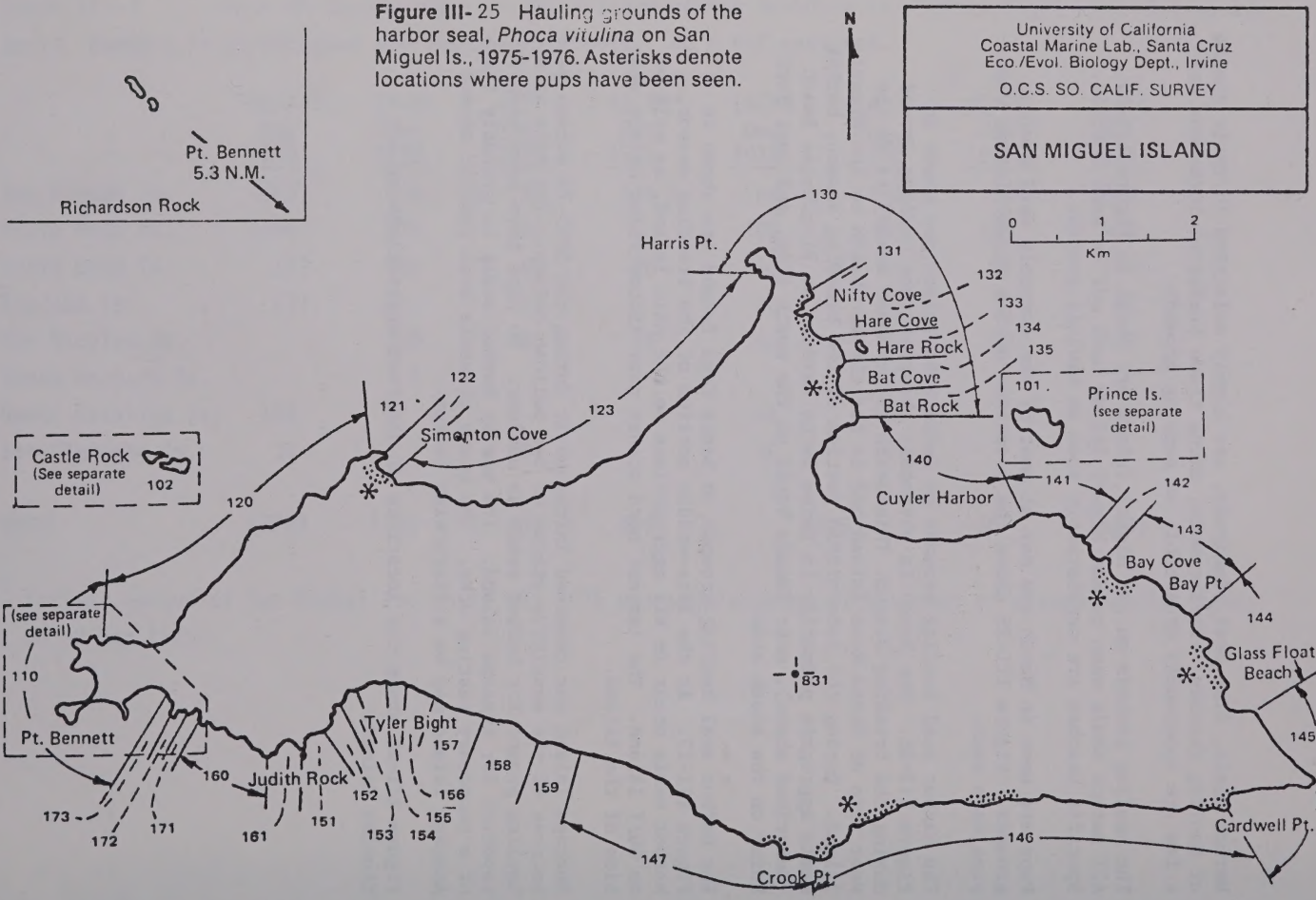
The harbor seal hauling grounds on Santa Rosa Island are shown in Figure III-26. One beach is obviously the preferred hauling ground during the breeding season. This beach (Blockhouse Beach) is at the west trip of Santa Rosa Island and is the closest beach to San Miguel Island. During the late-middle portion of the breeding season, harbor seals aggregate primarily in three large herds: at Blockhouse Beach (described above), near Canada Verde on the north side, and near Ford Point on the south side.

The harbor seal hauling grounds on Santa Cruz Island are shown in Figure III-27. At the late-middle portion of the breeding season, harbor seals occur in six aggregations on the main island, as well as on Gull Island. The largest herd occurs near Kinton Point on the west side of the island.

Anacapa Island was censused infrequently during the 1975-76 survey year because of the sensitive status of the pelican colony. Its role as a hauling ground for harbor seals is unclear. No pups have been seen or reported for Anacapa Island. Its use by harbor seals is probably that of a temporary resting area. The heavy pleasure boat traffic around Anacapa Island may be a disturbing factor.

Figure III-28 shows the locations of observed aggreations on San Nicolas Island.

**Figure III-25** Hauling grounds of the harbor seal, *Phoca vitulina* on San Miguel Is., 1975-1976. Asterisks denote locations where pups have been seen.



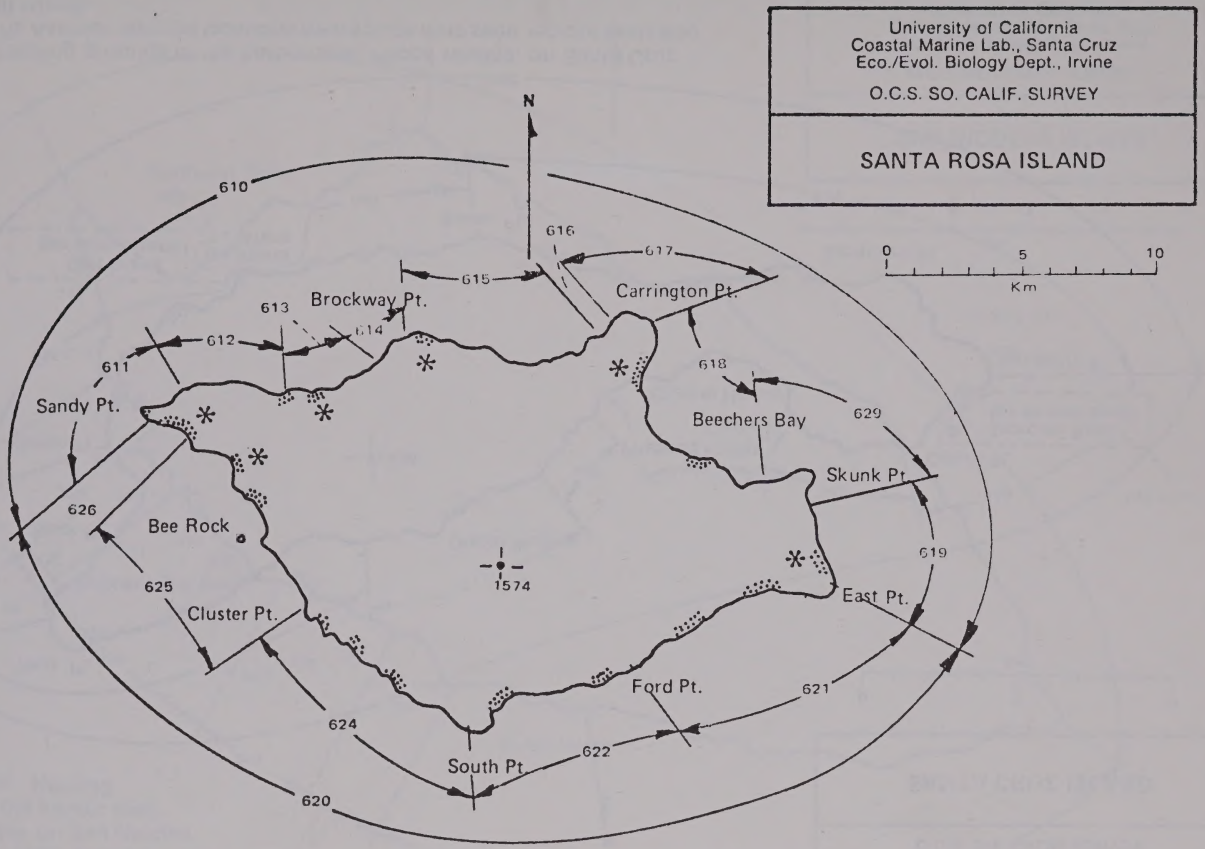



**Figure III-26** Hauling grounds of the harbor seal, *Phoca vitulina*, on Santa Rosa Island, 1975-1976. Asterisks denote locations where pups were seen.

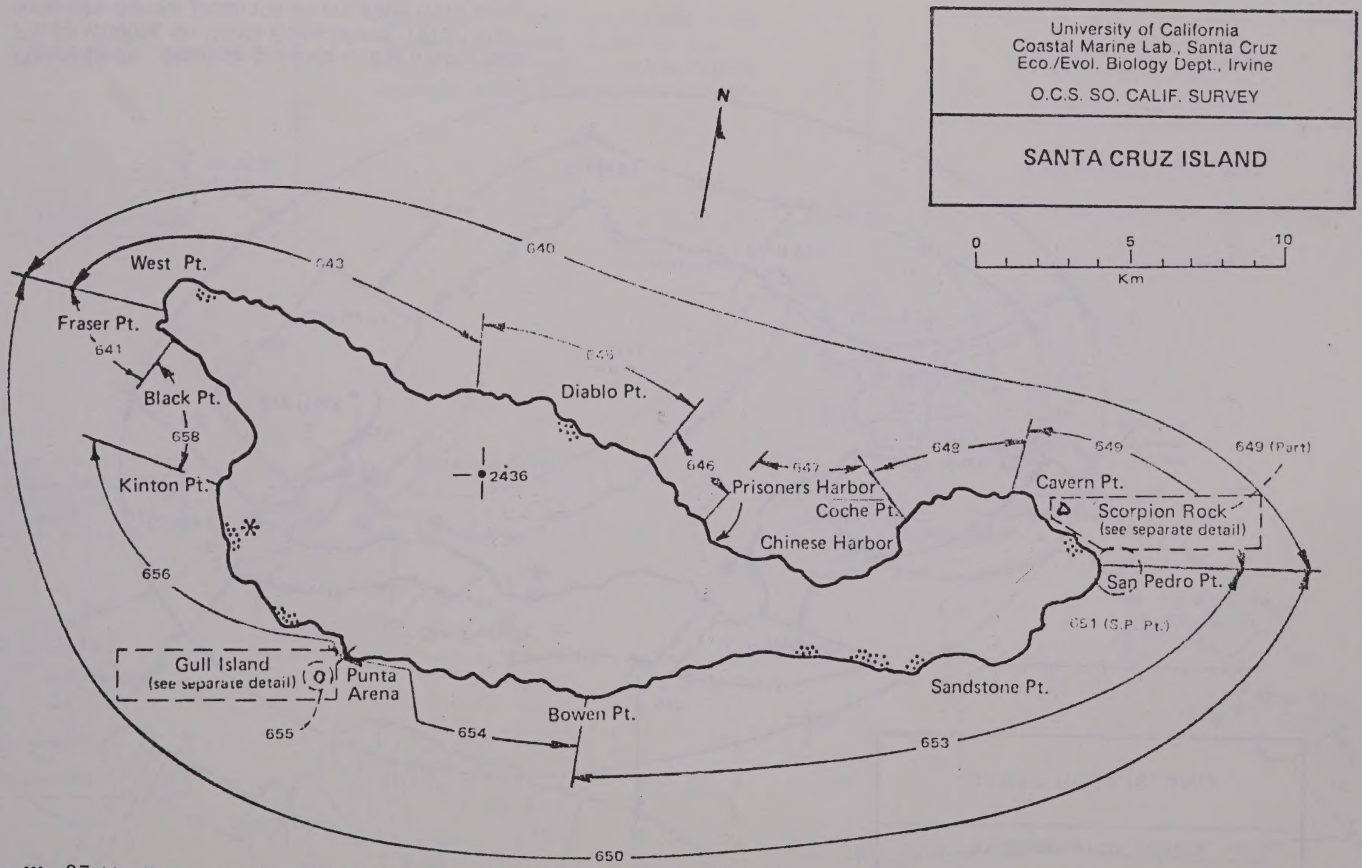



**Figure III-** 27 Hauling grounds of the harbor seal, *Phoca vitulina,* on Santa Cruz Island, 1975-1976. Asterisk denotes locations where pups were seen. Harbor seals also haul-out on Gull Island.

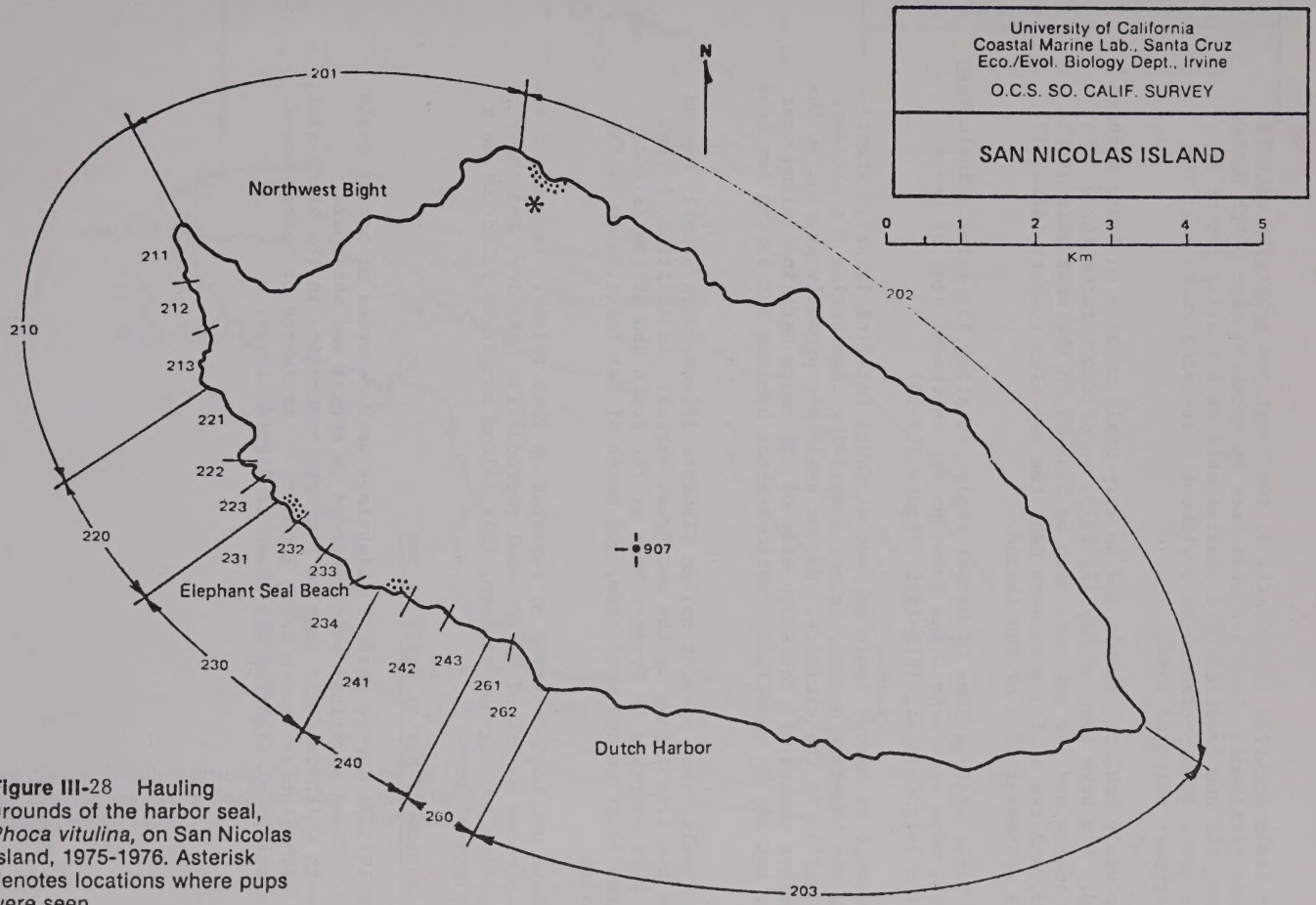



**Figure III-28** Hauling grounds of the harbor seal, *Phoca vitulina*, on San Nicolas Island, 1975-1976. Asterisk denotes locations where pups were seen.

Harbor seals occurred transiently at two locations generally occupied by other pinnipeds. They are also seen on occasion near Dutch Harbor. However, the one location used consistently as a hauling ground by harbor seals is a protected cove without flat-lying rocks near the northernmost point of land.

Harbor seals haul out rarely and in very small numbers on Santa Barbara Island. Six were seen on May 27, 1975, on offshore rocks (Area 306); three adults and one pup were seen on June 29 on the west side of the island, and two adults were seen near the sea lion rookery (Area 317) on the southeast side of the island.

Three large aggregations of harbor seals, totaling 152 animals including 23 pups, were seen near China Point on the southwest side of Santa Catalina Island during 1975-1976 (Figure III-29).

The absence of harbor seals on land at Santa Catalina Island, except during the breeding season, is not surprising considering the pleasure boat traffic in the vicinity. Harbor seals are probably present in the productive waters off the south side of the Santa Catalina Island year round, but may be especially cautious about hauling out during daylight hours.

Harbor seals, when present on San Clemente Island, were usually hauled out on the flat island in the northwest harbor. In addition, harbor seals were observed at Pyramid Head at the south end of the island, near Los Point on the west side, and north of Eel Point, also on the west side.

Pups have not been observed or reported on this island. Because of the inconspicuous nature of harbor seal reproductive behavior, and their unobtrusive hauling-out pattern, this island cannot be ruled out as a birthplace of pups.

Distribution of Harbor Seals at Sea

In the 1975-76 survey year, 13 sightings were recorded of harbor seals at sea. These sightings were recorded on aerial and shipboard transects which randomly sampled pinniped occurrence in the study area, i.e., without bias toward areas known to be preferred by harbor seals. The locations of sighting are shown in Figure III-24.

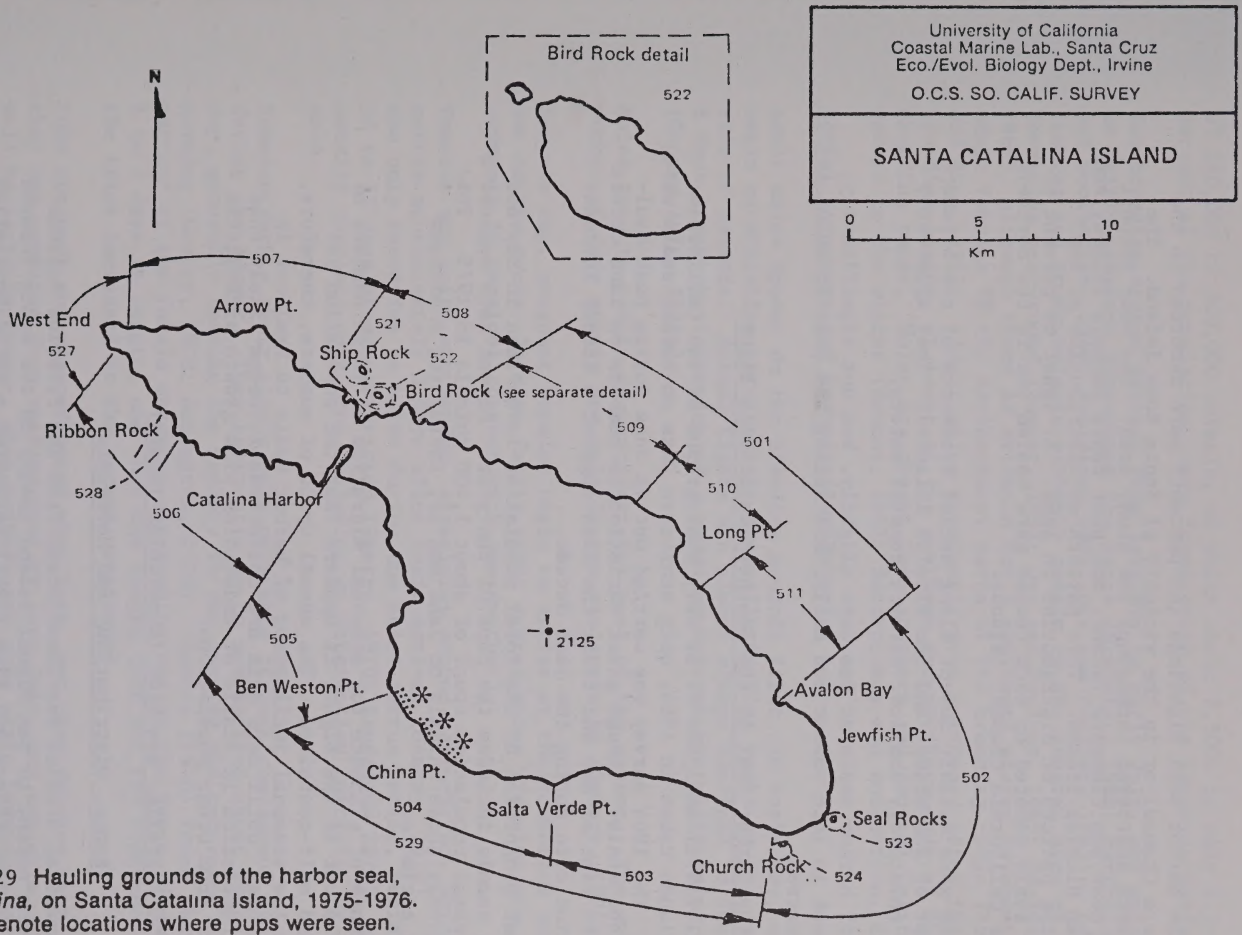



**Figure III-** 29 Hauling grounds of the harbor seal, *Phoca vitulina*, on Santa Catalina Island, 1975-1976. Asterisks denote locations where pups were seen.

Eight of the harbor seal sightings (61 percent) were recorded in the Santa Barbara Channel or in the vicinity of Santa Rosa Island. The remainder were scattered throughout the study area: one near Newport Beach, one near San Clemente Island, one near Santa Barbara Island, and two near San Nicolas Island. This pattern of distribution at sea reflected the pattern of distribution on land. At least 66 percent of the harbor seals counted on each census were hauled out in the northern tier of the California Channel Islands.

Harbor seals were notably absent along aerial transects of the offshore waters (west of San Miguel and San Nicolas Islands). They apparently prefer the relatively shallow, warmer, coastal waters.

Sightings of harbor seals at sea were slightly, but not significantly, more frequent in late summer and early fall during the post-breeding season dispersal.

Status of the Harbor Seal in the Southern California Bight

Until Odell (1971) analyzed U. S. Navy photographs of the California Channel Islands taken in 1964, only scattered data on harbor seals were available. The 1964 survey was carried out in June during peak haul-out of harbor seals. Though great variation in numbers on land occurs according to time of day and tide, the data suggest a steady increase in population size during the last decade.

The greatest proportion of the total population is on land in May and June; this sample includes the pups of the year. Recent data suggest a projected total population count of about 1,400 animals in 1975. This represents only those animals on land and is, therefore, a minimum population estimate.

In the absence of evidence for seasonal migration of large numbers of harbor seals out of the Bight, it appears that the population is discrete and self-contained. The annual cycle of numbers, therefore, shows only the seasonal inclination of harbor seals to haul-out in daylight hours. Until more data are collected, it seems likely that the Bight population is stable or undergoing slow growth with little recruitment from other populations.

5. Steller Sea Lion (Eumetopias jubata)

Range, Distribution, and Movements

In North America, Steller sea lions breed from the Pribilof Islands (59½N) in the north, to San Miguel Island (34¼N) in the south (Kenyon and Rice, 1961). Kenyon and Rice (1961) estimated a world population

of 240,000 to 300,000 animals, of which about 7,500, or only 2.5-3 percent of the population, were found south of the Canadian border.

The breeding season extends from late May to early July, and appears to be fairly constant throughout the range (Scheffer, 1958; Bartholomew and Boolootian, 1960; Spalding, 1964; Orr and Poulter, 1965). Adult females and young animals probably remain in the general area of the rookeries year-round (Bonnot, 1951; Orr and Poulter, 1965; Spalding, 1969), although there is evidence for a southward winter movement of adult females in the northernmost parts of the breeding range (Kenyon and Rice, 1961). Adult males apparently move northward after the breeding season, at least at the southern and northern ends of the breeding range. Males are absent from southern and central California waters in the winter (Bonnot, 1951; Bartholomew and Boolootian, 1960).

Social Structure and Reproductive Behavior

Adult males appear on the breeding grounds first, in early May, and begin establishing territories, generally on flat rocks on the seaward side of islands. Actual fights are almost always confined to the first 5 days after the formation of a boundary between two neighboring bulls (Gentry 1970, 1975a).

Males tend to remain on territory for most of the season. The average number of days ashore per male in one study was 46 (Gentry, 1970).

In late May, pregnant females begin to arrive at the rookeries and haul out on the rocks, forming fairly tight aggregations (females are commonly in physical contact with one another).

Females are quite aggressive, especially around parturition, which occurs approximately 3 days after their arrival (Gentry, 1970). They are only receptive to males during the brief estrus period, beginning 10 to 11 days after parturition (Gentry, 1970; Sandegren 1970), and usually copulate only once following an interaction initiated by the male.

Females suckle their single pups on a more or less continuous cycle during the summer. They apparently go to sea to feed about every third day, generally leaving the rookery in the evening and returning in the morning (Gentry, 1970; Sandegren, 1970). Gentry (1970) found that 75 percent of the female absences observed by him on Ano Nuevo Island were 1 to 2 days in length, and that the length (but not the frequency) of the trips increased as the season progressed.

Pups are weak and uncoordinated when born, but they develop rapidly; they are paddling from reef to reef by late July, and can swim quite well by early September, when mothers and pups begin leaving the rookeries (Orr and Poulter, 1967). The main cause of pup mortality,

which has been estimated to be from about 10 percent of the number of pups born (Gentry, 1970) to "high" (Orr and Poulter, 1967), is drowning. A few pups are crushed to death by males or abandoned to starve by their mothers.

Feeding Habits and Ecology

Steller sea lions eat a variety of prey items, both vertebrate and invertebrate. Among the species consumed are fish such as rockfish, clupeids (the herring family), flatfish, capeline, cod, salmon, hake, halibut, sculpin, whiting, greenling, sand lances, smelt and dogfish lamprey, and invertebrates such as squid, octopus, shellfish, and crustaceans (Mathisen, et al., 1962; Spalding, 1964; Fiscus and Baines, 1966).

The composition of the Steller sea lions' diet varies with the season, location of feeding grounds, and the size, age, and sex of a given individual, but some patterns have emerged in studies of sea lion stomach contents. In British Columbia, Spalding (1964) found Steller sea lions feeding predominantly on herring, whiting, and rockfish in the early spring when these fish are abundant in inshore water. Later, during the summer breeding season, their diet was composed mainly of octopus (which formed almost half the examined contents), rockfish, dogfish, and salmon.

Fiscus and Baines (1966) found the sea lions feeding on bottom fish (flatfish and rockfish) in California and Oregon waters, and on small, schooling fish such as capelin in Alaska, indicating that they feed near land or in relatively shallow water (less than 100 fathoms).

On the basis of daily fluctuations in stomach contents and haul-out patterns, Spalding (1964), Gentry (1970) and Mate (1975) have all depicted Steller sea lions as nocturnal feeders, at least at certain times of the year. Fiscus and Baines (1966) described a diurnal feeding pattern which they observed in Alaska in June and July, and May through October in two successive years (and also off San Miguel Island). The sea lions left the hauling grounds early in the morning, swam out 5-15 miles to feeding areas and then dispersed into groups of less than 50 animals which were generally mixed as to sex and age class. In late afternoon, the groups reformed and returned to the hauling grounds. The authors noted that this mass feeding behavior was only observed when large schools of squid or fish were available. At other times, the sea lions fed singly or in groups of two to five.

Population Size and Trends

A great deal of confusion surrounds the early history of the Steller sea lion in Southern California. Hunted as a source of oil, the sea lion populations were decimated by sealers in the nineteenth century

(Scammon, 1874), and, at the insistence of commercial fishermen, further attempts were made to reduce their numbers along the California coast during the early decades of this century (Bonnot, 1928).

Between 1927 and 1947 the southern California population fluctuated between a little over 600 to over 2,000 animals (Table III-4). Recently, the population seems to have stablized at a low level (Table III-5). Odell (1971) gives census figures for San Miguel Island in June, 1964, of 61 adults and 7 pups, and cites two unpublished reports of successful breeding on that island in 1969 and 1970. DeLong (1975) states that approximately 10 pups have been produced there each year since 1969.

Several authors have attempted to account for the decline of the Steller sea lion in Southern California. noting that the Steller sea lion is at the southern extreme of its range in this area, Bartholomew and Boolootian (1960) suggested that the resurgence of the California sea lion may have increased inter-specific competition between the two species for some food resource or rookery space during their concurrent breeding seasons. Mate (1975) described observations of California sea lion-Steller sea lion interactions in Oregon which lend support to the latter suggestion. Bartholomew and Boolootian (1960) also mentioned the increase in water temperatures which occurred in that area in the late 1950's, and discussed its possible effects on such factors as the composition of local prey species. However, this temperature increase was probably a temporary trend, as water temperatures appear actually to have been decreasing over the last several decades (Radovich, 1961; Ainley and Lewis, 1974).

Ainley and Lewis (1974) connected the decrease in numbers of Steller sea lions and two species of marine birds (the Double-crested Cormorant and the Tufted Puffin) to the decline of the sardine stocks in California waters in the 1940's. They argued that larger predators (such as the Steller sea lion relative to the California sea lion) would have been more severely affected by the loss of this prey species.

The effects of these and other factors, such as the harvesting or "control" of Steller sea lion populations in waters to the north of California (Spalding, 1964; Pearson and Verts, 1970), are extremely difficult to calculate. The decline of the Steller sea lion in the southern part of its range may never be satisfactorily explained.

Numbers and Distribution on Land

Few Steller sea lions were sighted during a one-year survey from May 1975 to March 1976. Census data from San Miguel Island in June and August of 1975 suggest that Steller sea lions are still breeding there in small numbers. A high count of 4 adult males, 12 females, and 3

Table III-4 Summary of California Department of Fish and Game June censuses of Steller sea lions on the Channel Islands, 1927 to 1947[1]

| Location | 1927 | 1928 | 1930 | 1936 | 1938 | 1947 |
|---|---|---|---|---|---|---|
| San Miguel Is. | 595 | 592 | 620 | 1359 | 1992 | 950 |
| Santa Rosa Is. | 49 | 38 | 12 | 52 | 20 | - |
| Santa Cruz Is. | 20 | 10 | 45 | - | 16 | - |
| San Clemente Is. | 1 | - | - | - | - | - |
| Total: | 665 | 640 | 677 | 1411 | 2028 | 950 |

[1]From Bonnot and Ripley (1948). Censuses taken subsequent to 1947 did not distinguish between Eumetopias and Zalophus and so are not included here.

Table III-5 Censuses of Steller sea lions on the California Channel Islands in 1958 and 1964.

| Date | Location | Males | Fem/SA Males | Pups | Total |
|---|---|---|---|---|---|
| 14 Feb. 1958[1] | San Miguel Is. | | 22 | | 22 |
| 11 June 1958[1] | San Miguel Is. | 9 | 25 | 3 | 37 |
| | Santa Rosa Is. | 2 | 15 | | 17 |
| | Santa Cruz Is. | 3 | | | 3 |
| | | | | | 57 |
| 20 June 1964[2] | San Miguel Is. | 19 | 42 | 7 | 68 |

[1]From Bartholomew and Boolootian (1960).

[2]From Odell (1971).

pups was obtained from photographs taken on 7 August 1975 on Richardson Rock. However, it was not certain from an inspection of the photographs that the three pups noted were actually Steller sea lion pups.

As expected from a consideration of the annual cycle, only adult females were observed on or around San Miguel Island outside of the breeding season. From 1 to 8 females were seen hauled-out on Richardson Rock or Castle Rock.

Considering its recent history, it does not appear likely that the number of Steller sea lions in the Bight will increase substantially during the next few years. As long as its population remains in so precarious a state, this species will bear careful watching.

### 6. Guadalupe Fur Seal (Arctocephalus townsendi)

#### Social Structure and Reproductive Behavior

Few studies have been made of the behavior of the Guadalupe fur seal, but its social system appears to be generally similar to that of other otariids (Peterson, et al., 1968b; Peterson and Ramsey, 1970; Peirson, unpublished data). During the May through July breeding season, adult males establish and defend territories on rocky, precipitous stretches of coastline along the east side of Isla de Guadalupe, Baja California.

Pregnant females usually begin arriving on the territories in June, and are immediately and closely attended to by the resident bulls. Several days after giving birth (11 days in one observed case (Pierson, 1975)), females come into estrus, copulate with the territorial male, and then go to sea. They continue to alternate bouts of nursing on shore with trips to feed at sea until the young are strong enough to follow, and maintain the mother-pup bond until at least February (Peterson, et al., 1968b; Pierson, unpublished data).

#### Range, Distribution and Numbers

As Peterson, et al. (1968b) suggested, changes in the sex and age composition of the population found ashore in different seasons indicate that the Guadalupe fur seal lives pelagically for a good part of the year. The "at-sea" distribution of this species is unknown.

In the nineteenth century, the Guadalupe fur seal was brought to the verge of extinction by intensive commercial sealing (Scammon, 1874; Hubbs, 1956).

The Guadalupe fur seal resurfaced on San Nicolas Island in 1949; in May through July of that year, Bartholomew made four separate sightings of what was apparently the same male fur seal (Bartholomew, 1950b). This triggered a renewed search for fur seals on Isla de Guadalupe, which finally ended successfully in 1954 with the discovery of a small population on the east shore of the island (Hubbs, 1956). Since that time, the Guadalupe population has continued to grow and is now estimated at between 500 and 1,000 animals.

The Guadalupe fur seal still breeds only on Isla de Guadalupe, and it is by far the rarest pinniped in the waters of the Bight. On 17 February 1968, a single young male was observed at Adams Cove on Point

Bennett, the westernmost tip of San Miguel Island (Peterson, Gentry and Le Boeuf, 1968a), and again on 24 August of that year, two animals, a young adult male and female or juvenile male, were seen in the same general area (Peterson and Le Boeuf, 1968). Since that time, National Marine Fisheries Service biologists resident on San Miguel have occasionally observed a few individuals, generally young adult males, during the species' May-July breeding season (DeLong, 1975).

Three sightings were recorded on surveys made during the first year of this study, but only two were confirmed by a photograph. On 27 June 1975, a young adult male Guadalupe fur seal was discovered hauled out high on a sand slide above a small cove on Point Bennett; on 4 August 1975, a Guadalupe fur seal was photographed on an offshore rock south of Mail Point (on the west side of the island); and on 25 January 1976, a large fur seal with a golden pelage and a ruff of guard hair on its neck and chest, probably an adult male, was observed in the water 65 km (40.4 miles) south of Santa Rosa Island on the Santa Rosa-Cortes Ridge (120¼ line of longitude).

While the Guadalupe fur seal is presently a rare and endangered species, restricted to breeding on one Mexican island, its population is slowing increasing in size. Therefore, this species may become more common in the Bight in the future, particularly during the summer months on San Miguel and San Nicolas Islnds, the two most oceanic islands in the area.

C. Cetaceans

Some broad outlines of the behavior and distrubution of the cetacean fauna of the Bight seem to emerge from recent work by Norris, et al., (1976), though variation in future years may be expected to obscure, as well as augment, some of the patterns. Some feeling for long-term variation comes from the historical data, but for the most part that source is so scattered and sketchy that it is seldom definitive.

In broadest scope, it can be discerned that each species of the cetacean fauna of the Bight undergoes annual shifts in distribution and abundance, some striking, and some more subtle, within the Bight. Probably all are part of larger scale movements involving relatively widespread and mobile populations extending both north and south of the Bight. Very few are precise movements that are sharply defined. Much more the norm is for a species to emphasize a given broad region in its distribution and to move incompletely in and out over months of time. When historical records are examined, boundaries are apt to become blurred even further. From time to time, most species have violated what seems to be the usual distributional rules for its species. For instance, the normally central Pacific pelagic false killer whale, Pseudorca crassidens, occasionally wanders as far inshore as Santa Catalina Island, an open ocean streaker dolphin, Stenella coeruleoalba,

strands, and the Northern Pacific Right Whale dolphin, Lissodelphis borealis, occasionally abandons its normal haunts on the continental margin to move close inshore near Newport Beach. Furthermore, and perhaps more fundamental, the main regions of occurrence seem to shift from year to year, perhaps in response to changes in oceanographic conditions that may be reflected in temperature and food supplies.

Nonetheless, it is possible to describe some distributions in quite firm terms. Gray whales migrate predominately inshore, though some individuals are found as far offshore as Tanner and Cortes Banks. Bottlenose dolphins are concentrated in the inshore part of the Bight, almost totally from Santa Barbara Island and south. Occasional strays go further north. The Eastern Pacific long-finned pilot whale is present in a singular concentration around Santa Catalina Island in the squid spawning season, with subsidiary sporadic concentrations at Palos Verdes Peninsula and La Jolla. It has been surprisingly scarce elsewhere at this time. Both the common dolphin, Delphinus, and the Pacific white sided dolphin, Lagenorhynchus, are widely spread throughout the Bight for most of the year, but one can discern a tendency toward northward movement in Delphinus, which has an inshore-offshore component in summer, and a similar movement northward and westward in Lagenorhynchus. In both cases, the movements are from warmer to cooler waters. Dall's porpoise and the killer whale both are much more common in the warm months, becoming widely dispersed throughout the Bight in the winter months. The northern right whale dolphin and the grampus are typically offshore forms that occasionally stray close inshore. But their seasons of movement into the area are opposite, the right whale dolphin entering the cold months and the grampus in the warm.

A migration path of the large baleen whales sweeps down the outer boundary of the Bight, and may be extended well out to sea beyond. Blue, humpback, fin, and sei whale records are concentrated in this band, and the sperm whale, known to associate with these animals farther north in California, was never seen, though for certain, it migrates past the Bight area. Probably it is a migrant in even deeper waters, at or beyond the actual continental slope. Minke whales are common within the Bight from July through December, being concentrated in the north in summer, and dispersing more widely later in the year. Spring records are largely from inshore areas (Norris, et al., 1976). Calving occurs in the Bight in winter and the earliest spring months.

The 1975-76 field survey conducted by Norris, et al., (1976) for BLM did not record some of the rarities that enter the area from time to time. None of the central tropical Pacific forms such as Pseudorca, or Steno were recorded. The secretive harbor porpoise, Phocoena phocoena, is known to occur as far south as Long Beach, California, but were not seen. The pelagic ziphiids are scarcely represented, while no record of the dwarf and pygmy sperm whales has been made.

Sightings tend to confirm the observation of Evans (1975) that cetaceans may cluster over underwater topography and can extend it to most species. It seems possible that the entire ecosystem is more concentrated and abundant in life over such topography than over the submarine plains such as are found west of San Clemente Island. If so, it would be expected that cetaceans, pinnepeds and birds are part of this concentration. Proof for or against this hypothesis awaits further analysis.

The data collected in 1975-76 allows learning about numbers of animals. The most abundant species is the dommon dolphin, Delphinus delphis, followed by the Pacific white sided dolphin, Lagenorhynchus obliquidens. The Dall's porpoise has proved surprisingly abundant, especially for a species thought to be extremely rare in Southern California as late as the 1950's. The same could be said ofthe Northern right whale, Lissodephis, which in season, is a common offshore species. Conversely, the restricted range of the pilot whale during the squid spawning season, means that the entire population may number in several hundreds or low thousands of animals.

The following species accounts were taken from U. S. Department of the Interior, 1975. The category of Study Area Sitings has been updated using Tables III-6, 7 and 8, which come from Norris, et al., (1976).

1. Pacific Right Whale (Balaena glacialis)

Range

Inhabits all temperate waters of the world. In the eastern North Pacific Ocean, the Right Whale ranges from Bristol Bay and the Gulf of Alaska south to 50¼N latitude during the summer, and from Oregon south to central Baja California during the winter.

Southern California Sitings

Between 1850-1870 whalers took these occasionally off San Diego. More recent sitings include: March, 1955, one sighted at La Jolla; January, 1956, four seen at La Jolla (Figure 12-1, Dailey, 1974).

Population

The Right Whale was originally very abundant, but heavy exploitation, mostly during the 19th century, reduced all populations to near extinction by the turn of the century. The North Pacific Ocean population is estimated at about 250 animals (Wada, 1972).

Table III-6

CETACEAN SIGHTINGS FROM SHIPBOARD;
NUMBERS OF ANIMALS BY SPECIES BY MONTH, 1975-76

| | II | | | III | | | IV | | | I | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | April | May | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | TOTAL |
| Pacific white-sided dolphin | | 10 | 8 | 158 | 120 | 1519 | | 59 | | 272 | 150 | | 2296 |
| Common dolphin | | 129 | | 1 | 1776 | 3820 | | 2556 | 8280 | 18 | 33 | | 16,613 |
| Dall's porpoise | | 47 | | 47 | | 23 | | 52 | 109 | 221 | 45 | | 544 |
| Bottlenose dolphin | | | | 25 | | 124 | | 42 | 217 | 87 | | | 495 |
| Northern right whale dolphin | | 151 | | | | | | 20 | 1 | 350 | 85 | | 607 |
| Grampus | | | | | | 65 | | | | | | | 65 |
| Minke whale | | 1 | | 20 | 9 | 16 | | 3 | 2 | | 1 | | 52 |
| Long-finned pilot whale | | | | 80 | 10 | 246 | | 167 | 1225 | 1431 | 12 | | 3171 |
| Gray whale | | 2 | | | | | | | 6 | 71 | 38 | | 117 |
| Blue whale | | | | 1 | 1 | 3 | | | | | | | 5 |
| Fin whale | | | | 2 | | | | | | | 2 | | 4 |
| Sei whale | | | | | | 5 | | | | | | | 5 |
| Humpback whale | | | | | | | | 5 | | | | | 5 |
| Killer whale | | | | | | | | | | 1 | | | 1 |
| *Mesoplodon sp.* | | | | | | | 2 | | | | | | 2 |
| Unident. >40' | | 1 | 1 | 4 | | 1 | | | | | | | 7 |
| Unident. 20'-40' | | 1 | 1 | 5 | | | 1 | | 4 | | 3 | | 15 |
| Unident. <20' | | 10 | | 227 | | 112 | | 12 | | | | | 361 |
| **TOTAL** | | 352 | 10 | 570 | 1916 | 5934 | 3 | 2916 | 9844 | 2451 | 369 | | 24,365 |

Table III-7

CETACEAN SIGHTINGS FROM AIRCRAFT;
NUMBERS OF ANIMALS BY SPECIES BY MONTH, 1975-76

| | II | | | III | | | IV | | | I | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | April | May | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | TOTAL |
| Pacific white-sided dolphin | | 2024 | 6 | 2540 | 70 | 100 | 292 | 1892 | | 12 | 7 | 768 | 7,711 |
| Common dolphin | | 100 | 12 | | 3441 | 2525 | 4237 | 2860 | 101 | 542 | 75 | 3058 | 16,951 |
| Dall's porpoise | | 1 | | | | | 26 | 20 | 31 | 5 | 20 | | 103 |
| Bottlenose dolphin | | 10 | | | | 3 | | | 22 | 27 | | | 62 |
| Northern right whale dolphin | | | | | | | | 50 | 545 | 475 | 171 | | 1,241 |
| Grampus | | | | 13 | 88 | | 21 | 350 | 15 | | 4 | | 491 |
| Minke whale | | 1 | | | | | | 7 | | | | | 8 |
| Long-finned pilot whale | | | | | | | 37 | 28 | 574 | 429 | 94 | | 1,162 |
| Gray whale | | 1 | | 4 | | 1 | | | 22 | 66 | 24 | 101 | 219 |
| Blue whale | | | | | 2 | | | | | | | | 2 |
| Fin whale | | | | | | | 8 | | 3 | | 1 | 7 | 19 |
| Sei whale | | | | | | | | | | | | | 0 |
| Humpback whale | | | | 1 | | | | | | | | | 1 |
| Killer whale | | | | | | | 100 | | 21 | | | | 121 |
| *Mesoplodon sp.* | | | | | | | | | | | | | 0 |
| Unident. >40' | | | | | | | | 1 | | 1 | 2 | | 4 |
| Unident. 20'-40' | | | | 2 | | 1 | | 1 | | | 1 | 2 | 7 |
| Unident. <20' | | | | 3 | | | 49 | 6 | 12 | 6 | | | 76 |
| **TOTAL** | | 2137 | 18 | 2563 | 3601 | 2630 | 4770 | 5215 | 1346 | 1563 | 399 | 3936 | 28,178 |

Table III-8

CETACEAN SIGHTINGS--COMBINED AIRCRAFT AND SHIP;
NUMBERS OF ANIMALS BY SPECIES BY MONTH, 1975-76

| | II | | | III | | | IV | | | I | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | April | May | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | TOTAL |
| Pacific white-sided dolphin | | 2034 | 14 | 2698 | 190 | 1619 | 292 | 1951 | | 284 | 157 | 768 | 10,007 |
| Common dolphin | | 229 | 12 | 1 | 5217 | 6345 | 4237 | 5416 | 8381 | 560 | 108 | 3058 | 33,564 |
| Dall's porpoise | | 48 | | 47 | | 23 | 26 | 72 | 140 | 226 | 65 | | 647 |
| Bottlenose dolphin | | 10 | | 25 | | 127 | | 42 | 239 | 114 | | | 557 |
| Northern right whale dolphin | | 151 | | | | | | 70 | 546 | 825 | 256 | | 1,848 |
| Grampus | | | | 13 | 88 | 65 | 21 | 350 | 15 | | 4 | | 556 |
| Minke whale | | 2 | | 20 | 9 | 16 | | 10 | 2 | | 1 | | 60 |
| Long-finned pilot whale | | | | 80 | 10 | 246 | 37 | 195 | 1799 | 1860 | 106 | | 4,333 |
| Gray whale | | 3 | | 4 | | 1 | | | 28 | 137 | 62 | 101 | 336 |
| Blue whale | | | | 1 | 3 | 3 | | | | | | | 7 |
| Fin whale | | | | 2 | | | 8 | | 3 | | 3 | 7 | 23 |
| Sei whale | | | | | | 5 | | | | | | | 5 |
| Humpback whale | | | | 1 | | | | 5 | | | | | 6 |
| Killer whale | | | | | | | 100 | | 21 | 1 | | | 122 |
| *Mesoplodon sp.* | | | | | 2 | | | | | | | | 2 |
| Unident. >40' | | 1 | 1 | 4 | | 1 | | 1 | | 1 | 2 | | 11 |
| Unident. 20'-40' | | 1 | 1 | 7 | | 1 | 1 | 1 | 4 | | 4 | 2 | 22 |
| Unident. <20' | | 10 | | 330 | | 112 | 49 | 18 | 12 | 6 | | | 537 |
| **TOTAL** | | 2489 | 28 | 3233 | 5519 | 8564 | 4771 | 8131 | 11190 | 4014 | 768 | 3936 | 52,543 |

Life History

Moderately migratory non-gregarious species remaining in high latitude temperate waters during the winter months. Food consists primarily of plankton (copepods) and small fish. The females breed on alternate years with the young being born between January and April, weaning at about 12 months. Age at maturity is not known, but body length is about 15.2 m in males and 15.8 m in females.

Diseases

Amphipoda (Cyamus erraticus, C. gracialis, C. ovalis).

2. Minke Whale (Balaenoptera acutorostrata)

Range

Bering Sea to Baja California and central Mexico.

Southern California Sitings

This species is the most common Balaenopterid in the Channel Island area. They are observed throughout the year but are most abundant during the winter (Walker, personal communication). Area sitings have been recorded by Norris and Prescott, 1961 (Figure 12-1, Dailey, 1974).

Population

Unknown for North Pacific but listed as about 200,000 in the southern hemisphere (Report of the Secretary of Commerce, 1973).

Life History

During the summer, they inhabit the high latitudes, moving south to warm water during the autumn and winter. They are known to feed heavily on krill (euphausiids), small fish (anchovy, saury) and squid. They attain sexual maturity at about 7 and 8 years, and calve only once every 2 years. They are usually seen singly or in small pods (2-5). Norris and Prescott (1961) state that calves were seen during the winter months indicating the probability that birth was given during this period.

Diseases

Amphipoda (Cyamus balaeopterae).

3. Sei Whale (Balaenoptera borealis)

Range

Nearly world-wide. In the eastern North Pacific, it summers from Alaska to California.

Southern California Sitings

Rice (1963) records the siting of one Sei Whale behind San Clemente Island on November 17, 1962 (Figure 12-1, Dailey, 1974). This indicates their presence in these waters and that they are probably more prevalent than sitings would indicate.

Population

The Report of the Secretary of Commerce (Administration of the Marine Mammal Protection Act of 1972, December 21, 1972 to June 21, 1973) lists stock sizes available for commercial harvest are estimated to be about 80,000 in the southern oceans and 33,000-37,000 in the North Pacific Ocean. This estimate does not consider unharvestable young whales. In this report, the Sei Whale is listed as the second most valuable baleen whale, and that its populations appear to be near the level of maximum sustainable yield.

Life History

The diet of this species consists of euphausiids, copepods, sauries, anchovies, herring, sardines and jack mackerel. Sei Whales usually travel in small pods (2-5), attain sexual maturity at 6 to 12 years and females bear calves every 2 to 3 years. The mating and calving occurs in the winter, with gestation lasting one year; and weaning takes place at about 7 months past parturition.

Diseases

Tremadtoda (Lecithodesmus sp., L. spiosus, Ogmagaster plicatus); Cestoda (Diphllobothrium spp., Tetrabothrius sp.); Nematoda (Anisakis sp., A. simplex, Crassicauda sp.); Acanthoecephala (Bolbosoma sp., B. turbinella); Copepoda (Penella balaenoptera). The Secretary of Commerce report mentions a unique disease (found in 7 percent of those taken in California) which causes a progressional shedding of the baleen plates and their replacement by an abnormal papilloma-like growth.

4. Finback or Fin Whale (Balaenoptera physalus)

Range

Nearly world-wide. In the eastern North Pacific, it summers from California to the Chukchi Sea.

Southern California Sitings

The only published siting is by Rice (1963), who reports siting about 57 Fin Whales in 23 pods during the month of November, 1972. All but a few were recorded in waters southwest of San Clemente Island (Figure 12-1, Dailey, 1974).

Population

The report from the Secretary of Commerce (1973) gives an estimated 120,000 Fin Whales (of harvestable size) world-wide. Of this number, 10,000 to 13,000 are estimated from the North Pacific area. In the same report they state that the Fin Whale is commercially the most valuable baleen whale, and that stocks in the North Pacific and southern ocean are below maximum sustainable yield levels.

Life History

This species is second only to the Blue Whale in size, reaching a length of at least 23 m (75.5 feet). It feeds mostly on euphausiids but often takes fish, especially anchovies. They usually travel in small pods of 2 to 5 animals. They reach sexual maturity at 6 to 12

years, and the females bear calves every 2 to 3 years. Mating and calving occurs in winter, with the gestation period lasting 1 year, followed by weaning at about 7 months.

Diseases

Amphipoda (Cyamus balaenopterae); Trematoda (Lecithodesmus goliath, Ogmogaster antarcticus, O. plicatus, O. trilineatus); Cestoda (Phyllobothrium delphini); Nematoda (Anisakis sp., Crassicauda sp., C. pacifica); Copepoda (Penella balanopterae).

5. California Gray Whale (Eschrichtius gibbosus)

Range

Bering Sea and Arctic Ocean to Baja California.

Population

Since the latter half of the 19th century it has been no longer profitable to hunt them. In 1938, they were given complete protection by international treaty. Adjusted counts taken from 1969-1970 totaled 10,906 animals (Rice and Wolman, 1971). It is estimated that the population has a consistent increase of about 11 percent a year. Leatherwood, et al., (unpublished) lists this whale as the most abundant Mysteciti from Point Conception to Ensenada.

Life History

Gray Whales usually travel within a few miles of shore while migrating from their summer grounds in the Bering and Chukchi Seas to their winter grounds along the coast of Baja California. The northward migration tends to follow the same course, except females and calves travel offshore. Feeding consists of benthic amphipods of which Ampelisca macrocephala predominates (Rice and Wolman, 1971). Virtually no feeding takes place during the migration through Southern California waters; and little evidence is found that they feed after arriving at their winter grounds. The peak of breeding takes place in December, with gestation lasting about 13 months. Lactation lasts an average of 7 months ending in August.

The Killer Whale (Orcinus orca) appears to be the only predator of this whale. The number killed per year is unknown, but tooth scars of unsuccessful attacks are frequently seen. There is an inference that the number of sitings are declining due to increased boat traffic in the Catalina Channel. Whales are now passing off the backside of Catalina (Walker, personal communication).

Diseases

A high percentage of ectoparasitic infections are reported by Rice and Wolman (1971): the barnacle Cryptolepas rhachianecti found on 100 percent of the animals examined followed by whale lice, Cyamus scammoni (99.7 percent, C. ceti (99.4 percent and C. kessleri (98.1 percent). Endoparasites reported are: Trematoda (Lecithodesmus goliath, Ogmogaster pentalineatus, O. antarcticus); Cestoda (Priapocephalus sp., Tetrabothrius sp.); Nematoda (Anisakis simplex); Acanthocephala (Corynosoma sp., Bolbosoma sp). The liver fluke, L. goliath, was the only parasite to cause any pathogenic affect.

6. False Killer Whale (Pseudorca crassidens)

Range

Widely distributed in the temperate waters of the Northern and Southern Hemispheres; but on the west coast it occurs from Puget Sound, Washington to Acapulco, Mexico. The distribution of this species closely resembles that the Pilot Whale, but the latter penetrates deeper into the polar regions.

Southern California Sitings

A total of six skulls of this animal were found on San Nicolas Island between 1940 and 1960. Mitchell (1965) considers this as evidence of a mass stranding. Also, in 1959 a school of about 300 was seen near Santa Catalina Island. In October 1963, 200 to 300 animals were seen 4 miles off Palos Verdes Peninsula and one 11-foot female was captured by Marineland off the Pacific. Judging by strandings, the False Killer Whale appears in the coastal zone very irregularly (Figure 12-2, Dailey, 1974).

Population

There is no data on the current population of this species, but judging by the size of the stranded schools, it exists in considerable abundance.

Life History

Movement of this species occurs in large groups. Food primarily consists of cephalopods and fishes. In stranded schools, males and females occurred in equal numbers. From necropsy evidence, it appears that P. crassidens mates during the winter (December) as a nearly full-term fetus was found in November.

Diseases

Two species of trematodes (Nasitrema attenuata and N. globicephalae) have been recorded from this host off the western coast of North America.

7. Killer Whale (Orcinis orca)

Range

In the Pacific, they are known to range from Alaska to Costa Rica but are considered a cosmopolitan species.

Southern California Sitings

These whales are seen occasionally in the Catalina Channel and around the Channel Islands during the entire year; predominantly during Gray Whale migrations (Walker, personal communication).

Population

No data on population figures have been reported. However, since they have no known natural predators and are not hunted commercially, locally, it can be assumed with some certainty that a large stable population exists. Their only enemy is man.

Life History

Killer Whales have no reported migration pattern but wander the seas in large groups. Feeding behavior of Killer Whales have been documented (Tomlin, 1957). Stomach samples have shown numerous types of fish, including sharks, also penguins and other sea birds as well as almost all representatives of the cetacea and pinniped groups. Killer Whales are voracious feeders. According to Eschricht, 1862 (Tomlin, 1957), a 180 x 130 cm (70.8 x 51.2 inches) stomach of a 6.5 m (21.3 feet) whale yielded five or six seals and semidigested remnants of 6-7 more seals and 13 porpoises; in addition, two almost intact seals were found in the esophagus of the Killer. Killer Whales hunt in packs and seem to prefer Gray Whales and various pinnipeds, but apparently attack any sea animal that can't outswim them. Breeding has been recorded from March and April through July (Scheffer and Slipp, 1948). Gestation is about 1 year, after which the calf leaves the mother.

Diseases

The most frequent non-parasitic disease listed is a tooth infection caused by the wearing down on the tooth crowns. The animal then suffers from jaw abscesses. The stomach roundworms of the genus Anisakis are the only internal parasite recorded form the west coast of

North America. Scheffer and Slipp, 1948) reported 5,000 of these worms from a single Killer Whale stomach.

8. Pacific Pilot Whale (Globicephala macrorhyncha)

Range

Alaska to Central and Southern America.

Southern California Sitings

Seen fairly commonly in the Catalina Channel at all times of the year, being most abundant during squid season (April-June) (Walker, unpublished). Last documented strandings were on January 18, 1971, at Pyramid Cove, San Clemente Island (17 animals) (John Hall, personal communication).

Population

No population figures are available but numerous sitings would indicate a large, stable population in the Southern California area (Walker, personal communication). Pilot Whales are still taken commercially in Japan. Leatherwood, et al., (unpublished) lists this whale as the fourth most abundant Odontoceti from Point Conception to Ensenada.

Life History

Pilot Whales travel offshore, usually in pods of 15 to 25 animals. Their main diet consists of cephalopods (squids) and gregarious fishes. Pilot Whales appear in bays and lagoons on rare occasions, as a result of following schools of fishes during feeding. Their main breeding season is during the summer months with gestation and lactation lasting about a year each.

9. Hubb's Beaked Whale (Mesoplodon carlhubbsi)

Range

North Pacific Ocean.

Southern California Sitings

There are only three published California records: One from a stranding at La Jolla, San Diego Co., in 1945, and two from Northern California (Drakes Bay, Marin Co., 1950; San Simeon, San Luis Obispo Co., 1962). (Figure 12-2, Dailey, 1974).

Population

Considered rare throughout its range. No population estimates available.

Life History

No information available.

Diseases

A specimen stranded in Santa Barbara (May 2, 1972) was infected with three parasites: Penella sp., Phyllobothrium sp., and an unidentified trematode in the liver.

10. Cuvier's Beaked Whale (Ziphius cavirostris)

Range

Occurs in all oceans. Recorded from Alaska to California on the western coast of North America.

Southern California Sitings

Five reports of one each from the following: Del Mar, San Diego Co., 1945; Santa Catalina Island, 1957; North Island, San Diego Bay, 1957; Newport Beach, 1963, siting at sea 33¼26'N, 119¼19'W, 1964 (Figure 12-2, Dailey, 1974).

Population

No published numbers on population but appear regularly in Japanese waters (Nishiwaki, 1972).

Life History

This species reaches a maximum of just over 6 m (19.7 feet). Its life history has been little studied but it reportedly feeds on squid (preferably), fish, sea cucumbers, crabs and starfish. Information on mating is not available, but calving is thought to take place primarily in the fall (full-term fetuses have been found in August and September according to Tomlin, 1957). These animals travel in small groups and are not conspicuous.

Diseases

Only nematodes from the genus Anisakis have been reported from this host on the west coast of North America. However, the larval tapeworm

Phyllobothrium sp. and two other tissue roundworms of the genus Crassicauda are reported from the general literature.

### 11. Pygmy Sperm Whale (Kogia breviceps)

#### Range

This species occurs world-wide in temperate and tropical waters.

#### Southern California Sitings

This species is rarely observed at sea in the study area. There have been fewer than 100 records of it since its description in 1871. Nine recorded sitings are listed in Daugherty (1965) during the last 38 years. Eight of these were from Southern California. All but two of the sitings were from the San Diego area. One from Cabrillo Beach, San Pedro (1960) and a 1966 stranding in the Santa Monica/Playa del Rey area (Walker, personal communication).

#### Population

The industrial yield of the Pygmy Sperm Whale is very small. This, in conjunction with rare sitings, make it impossible to estimate its population.

#### Life History

Small whales reaching a maximum size of 4 m (13.1 feet). The food of this species is very little known as is its biology in general. From stomach samples, it apparently feeds on squid, fish, and crabs. Breeding is thought to occur in late summer, with parturition taking place in the spring after only 9 months. May is suggested but this is questionable according to Anderson and Jones (1967).

#### Diseases

There are no reports from animals collected on the west coast of North America but two larval species of Cestoda (Phyllobothrium delphini, Monorgyma grimaldii) and five species of Nematoda (Anisaki's simplex, Crassicauda magna, C. duguyi, Phocanema sp., Pseudoterranova kogiae) are listed for this host by Dailey and Brownell (1972).

### 12. Sperm Whale (Physeter catadon)

#### Range

Listed in the Pacific as ranging from Alaska to South America. On a world-wide basis they exist from 70½N to 70¼S. Unlike other cetaceans, the ranges of male and female sperm whales do not coincide; the

distribution of the females is much narrower, not exceeding, as a rule, the limits of the tropical and sub-tropical zone. The majority of Sperm Whales inhabit the zone extending from 40¼N to 40¼S latitude.

Southern California Sitings

There have been two records of the Sperm Whale in the study area. One siting from mid-Catalina Channel in July, 1971 (Walker and Poorman, personal communication) and a stranded male (59-foot) between Oceanside and Camp Pendleton on December 27, 1972 (Don Patten, personal communication). (Figure 12-3, Dailey, 1974).

Population

There is no estimate of the world population. The North Pacific population is estimated at 70,000 to 100,000 animals according to Nishiwaki (1972). Tomlin (1957) states that over 11 years of whaling (1919-1929) off the western coast of North America, 1,217 Sperm Whales were taken out of the total 15,985 whales of various species. Of these, only 22 were from lower California. Their numbers can be considered negligible in Southern California waters.

Life History

These are large whales reaching to 19 m (62.3 feet) in length. The main diet of Sperm Whales consists primarily of cephalopod molluscs. Fishes appear to be of little importance being chiefly in inshore waters. Among fishes, the prominent food items are elasmobranches (mostly skates, less often sharks), the teleosts being only of secondary importance. Other food, including small pinnipeds, are swallowed accidently or when no other food is available. In the Northern Hemisphere, April is the peak of the breeding season with parturition occurring after a 16-month gestation period. Lactation lasts about 13 months, with sexual maturity reached at about 8 to 9 years. Sperm Whales are believed to live a maximum of 70 years.

Diseases

Jaw abscess from tooth wear has been reported as has eye infection. Skin lesions caused by ectoparasites (diatoms; amphipods - Cyamus catodontis, Neocyamus physeteris; barnacles) are reported as a major problem. Endoparasites include cestode larval forms (Phyllobothrium delphini) and nematodes (Anisakis spp., Placentonema gigantissma).

13. Common Dolphin (Delphinus delphis)

Range

Occurs world-wide. Found from British Columbia to Baja California on the west coast of North America.

Southern California Sitings

Found abundantly offshore throughout the study area. Telemetric studies indicate that these dolphins are more common over or near underwater seamounts, ridges, etc. (Evans, 1971).

Population

Estimated at more than 30,000 by Nishiwaki (1972), but this is probably a conservative estimate. Leatherwood, et al., (unpublished) lists this dolphin as the most abundant cetacean from Point Conception to Ensenada.

Life History

D. delphis feeds chiefly on schools of migrating fish (herring, anchovies, sardines, etc.) and squid (beaks always present in stomach). Food preferences are similar to the white-sided dolphin (Walker, personal communication). Sexual maturity is reached in females at 3, and males at 4 years. Mating takes place in the fall, with gestation lasting 10 months. Females migrate offshore in summer and calve in open sea. Individuals are assumed to live 25 to 30 years.

Diseases

This species is the most commonly found stranded (beached) animal in the study area. Stranded animals are found to be heavily parasitized with trematodes of the genus Nasitrema. Massive brain lesions are caused by this fluke resulting in the loss of equilibrium and most probably echolocation ability (Ridgway and Dailey, 1972). The larval cestodes Phyllobothrium delphini and Monorygma are found commonly in the blubber and peritoneal cavity, respectively (Walker, unpublished). Gastric ulcers were observed by Brown and Norris (1956), with the probable etiological agent being stress. One case of parasitic peritonitis is reportedly caused by heavy infection of Anisakis -Dailey and Walker (in press).

14. Pacific Striped or White-Sided Dolphin (Lagenorhynchus obliquidens)

Range

Found in the north Pacific, abundant in Japanese waters and along the west coast of North America.

Southern California Sitings

Very abundant in the Catalina Channel and throughout Southern California waters.

Population

Schools of up to 1,000 animals have been reported. Nishiwaki (1972) estimates the species near Japan, alone, numbers between 30,000-50,000. Leatherwood, et al., (unpublished) lists this dolphin as the second most abundant Odontoceti from Point Conception to Ensenada.

Life History

This species moves in large herds feeding on squid preferably, but also taking small pelagic fishes. The breeding season and parturition occurs from spring to summer. These animals keep well in captivity and are used extensively as show animals in oceanaria.

Diseases

No external, gross diseases have been noted for this species. However, like Delphinus delphis, it is commonly found stranded during the spring and summer months. Massive brain lesions involving the parasites Nasitrema (both eggs and adults) have also been found in these beached animals by Dailey and Walker (unpublished). The transmission of this fluke is unknown at the present time.

15. Northern Right Whale (Lissodelphis borealis)

Range

North Pacific-Bering Sea to Southern California.

Southern California Sitings

Actual specimens reported are: Torrey Pines, San Diego, 1956, Manhattan Beach, 1960; Marineland of the Pacific has occasional sitings in the Catalina Channel and around the Channel Islands from February to May. One was captured by Marineland for exhibition in 1973 (personal observation). However, they are not seen commonly (Walker, personal communication). (Figure 12-4, Dailey, 1974).

Life History

This species feeds mainly on squid and pelagic fish. They generally form large herds, are very fast swimmers (35 km/hr) and avoid boats. Little work has been done on the breeding behavior of this animal.

Population

The population is estimated at more than 10,000 animals. Leatherwood, Green and Walker (unpublished) lists this species as the third most abundant Odontoceti from Point Conception to Ensenada.

Diseases

The helminth parasites of Nasitrema globicephalae, Penella sp. (heavy), Monorygma, Phyllobothrium, Crassicauda, and Anisakis are reported from this host (Dailey and Walker, in press).

16. Harbor Porpoise (Phocoena phocoena)

Range

Although this species is very common in the North Atlantic, it is also widely distributed in other parts of the world. In the Eastern Pacific, they range from Point Barrow, Alaska to central California and occasionally into Southern California.

Southern California Sitings

Extremely rare. One reported from Los Angeles Harbor (Daugherty, 1965) and one living specimen from Oxnard-Pt. Hueneme taken in a gill net on May 3, 1963 (Walker, personal communication). (Figure 12-4, Dailey, 1974).

Population

Abundant in the North Atlantic and Eastern North Pacific.

Life History

P. phocoena feeds on fish, squid and crustaceans. Breeding takes place in July and August followed by 9 to 10 months gestation period. Harbor porpoises stay in small groups of 2 to 10 individuals, aggregating in large schools only during the run of schooling fishes. They stay near shore and commonly invade bays and lagoons.

Diseases

Two species of trematodes (Campula oblonga, Hadwenius nipponicus), one larval Cestoda (Pyramicocephalus phocarum), three nematodes (Halocercus invaginatus, Pharurus convolutus, Stenurus minor) and one acanthocephala (Corynosoma alaskensis) have been reported from this porpoise.

17. Dall Porpoise (Phocoenoides dalli)

Range

Inhabits cold waters of the North Pacific including the Bering Sea and Aleutian chain. They also extend southward to Baja California.

Southern California Sitings

This species is seen in fairly large numbers throughout the coastal zone 10-12 miles offshore. Groups of 5 to 10 are seen in the Catalina Channel area throughout the year. More abundant in winter and spring months (Walker, unpublished).

Population

Nishiwaki (1972) states that the population of the northwestern North Pacific may be as many as 50,000 animals. There are no published figures for the large stable population as schools of 100 or more have been reported by Daugherty (1965). Leatherwood, et al., (unpublished) lists this porpoise as the fifth most abundant Odontoceti along with T. gilli from Point Conception to Ensenada.

Life History

There is little information on the biology of this species. They apparently feed predominantly on squid and schooling fishes, hake and juvenile rockfish very common. Reproduction periods have not been recorded; however, fetuses found in April and May measured only 30 m (11.8 inches) while those found in June were 80 to 90 cm (31.5 to 35.4 inches). This would indicate parturition occurs during the summer.

Their behavior indicates they remain in small herds when near shore but form groups up to 1,000 animals in open ocean or at popular feeding grounds.

Diseases

Reports from this species taken in eastern Pacific waters include nematodes (Anisakis simplex, Crassicauda, Halocercus Kirbyi, Placentonema sp., Stenurus minor, Pharaurus dalli) and trematodes (Campula oblonga, Nasitrema dalli) and trematodes (Campula oblonga, Nasitrema dalli). Biliary fibrosis and pulmonary granulomas have been listed from this species as a result of parasitic infection.

18. Long-Beaked Dolphin or Blue-White Dolphin (Stenella caeruleoalba)

Range

Has been reported form the Atlantic and Pacific Oceans, also the Mediterranean Sea. In the Pacific, it has been recorded from the Bering Sea to Southern California.

Southern California Sitings

The only recorded California sitings are from the study area; one from the vicinity of San Diego; one from a beached specimen near Santa Monica Bay in 1960; and a recent stranding in Long Beach Harbor (at the food of Junipero Street) occurred on March 21,1973 (Walker, personal communication). (Figure 12-4, Dailey, 1974).

Population

Even though this species is uncommon in Southern California waters, Nishiwaki (1972) lists the Pacific population at 15,000 to 200,000 animals. The Blue-White Dolphin is taken commercially in limited numbers by the Japanese.

Life History

The primary food of this species is squid with Loligo sp. listed as predominant. Two distinct breeding seasons, spring and fall, are reported by Nishiwaki (1972) with parturition occurring in spring and autumn. Lactation lasts from 6 to 12 months, and sexual maturity attained at 4 years. This dolphin is reportedly easily frightened by human activity and can be easily herded into bays for harvesting. They are assumed to live from 25 to 30 years.

Diseases

The cestode larvae Monorygma sp. and Phyllobothrium sp. are listed as parasites of the mesenteries and blubber, respectively. Also, the nematode Anisakis sp. is reported from this host.

19. Pacific Spotted Dolphin[a] (Stenella graffmani)

Range

This species is very abundant in the eastern tropical Pacific most commonly occurring from Cape San Lucas in Baja California to Columbia, South America. They are rare in Southern California waters.

[a]This species listed as Stenella dubia by Rice and Sheffer, 1968.

Southern California Sitings

There is one record from the vicinity of San Diego, and a very uncertain report of another having been taken by a commerical fisherman in the Channel Islands region (Daugherty, 1965). (Figure 12-4, Dailey, 1974).

Population

This species is seen in very large schools and run with the tuna. For this reason they have been harvested in large numbers with tuna catches. There is concern about their numbers if this practice continues. Special escape nets are now being developed by the National Marine Fisheries Service, hopefully, to remedy this situation.

Life History

Reproductive information is available in Harrison, et al., (1972). Feeding apparently includes squid and fish. They inhabit open ocean and frequently stay close to ships for hours.

Diseases

Dailey and Perrin (1973) lists 10 genera and 11 species of parasitic helminths found in this porpoise. Severe problems in the pancreatic duct, skull region and colon area are indicated as a result of these infections.

D. Carnivores

1. California Sea Otter (Enhydra lutris)

As one of the marine mammal species that suffered severe setback in numbers from the fur trade, such that the population off coastal California was considered on the verge of extinction at the turn of the century, this species has made a remarkable response to strong conservation measures. Historically, sea otters were distributed from central Kamchatka, north of Japan, across the Commander Islands, Pribiloff Islands, Aleutian Islands, along the Alaskan Peninsula, coastal Alaska, Canada, and the United States to about Morro Hermosa, Baja California, Mexico at 27 degrees 32 minutes north latitude (Kenyon, 1969; Miller, 1974). The present distribution is shown in Figure III-30 for the central and northern California coast.

A statistical study of sea otter subspecies (Roest, 1973) provided overwhelming support of invalidation of the subspecies E.I. neris originally described by Merriam (1904). Roest (1973) recognized only two valid subspecies, E.I. lutris and E.I. gracilis. Recently, Davis

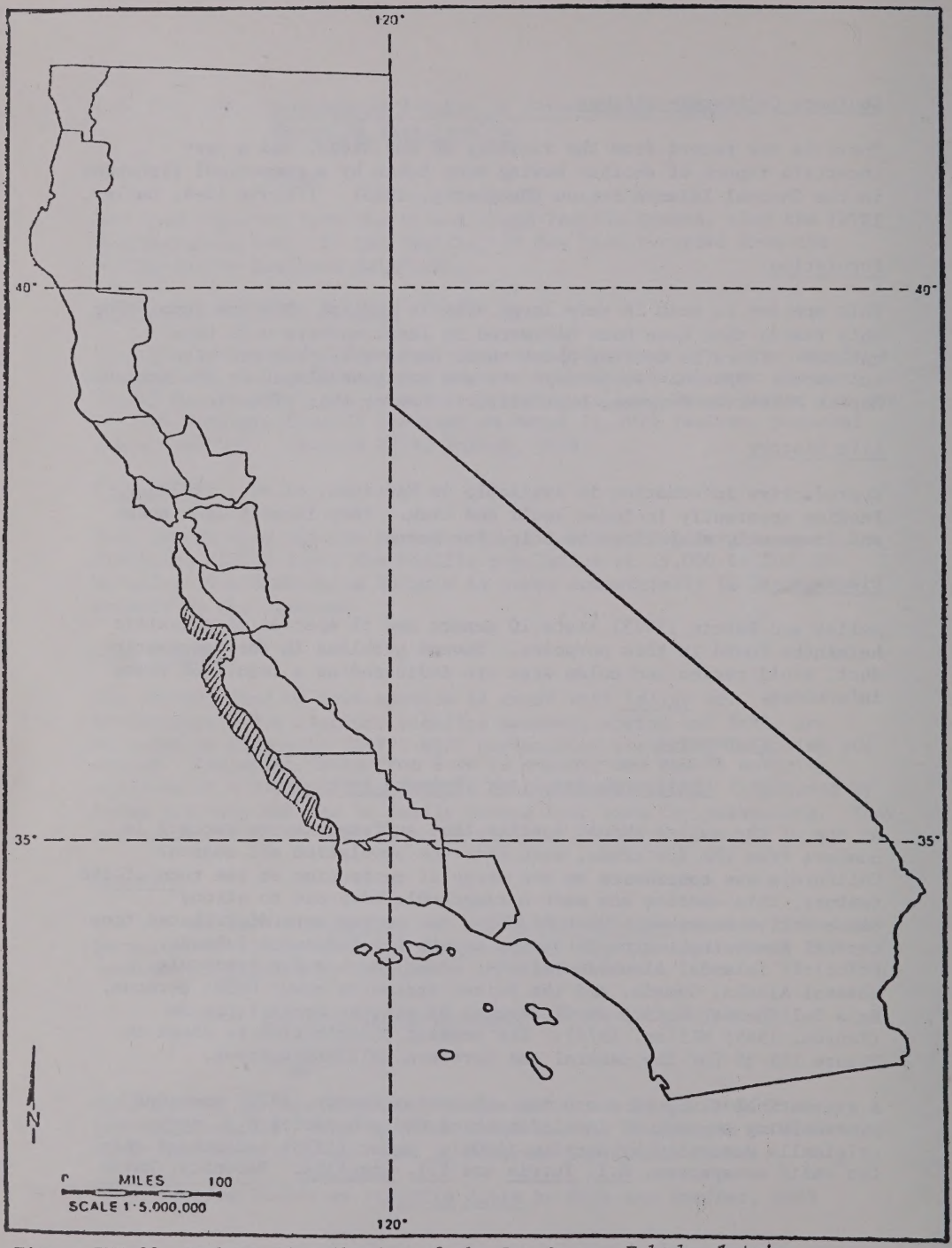



Figure III-30 Inshore Distribution of the Sea Otter, *Enhydra lutris*.

and Lidicker (1975) contested the studies of Roest and provided behavioral evidence to resurrect E.I. neris.

## Life Cycle

As a typical mustelid carnivore with numerous terrestrial cousins, the sea otter female after breeding has a period of delayed implantation of the blastocyst; this together with actual gestation takes some 8-9 months (Kenyon, 1969; Schneider, 1972). Pupping in the Alaskan region occurs during the spring and summer months (Kenyon, 1969), and off coastal California during winter and early spring (Wild and Ames, 1974; Miller, 1974).

## Breeding Areas

Based on the studies of Wild and Ames (1974), sea otters segregate according to level of reproductive state. Males mostly occur at the northern and southern ends of distribution along coastal California; and reproductive females, pregnant females, and females with pups are found primarily at the center of their distribution. Pups are born throughout the year, but most births occur over a 3-month period extending over winter and spring. Age at sexual maturity is not clear. To date, no known-age animals have been studied in this regard. Kenyon (1969) estimated most Alaskan sea otters to be sexually mature at about 5-6 years of age or 50-60 pounds in weight. By use of the cementum layers around the roots of premolars, Schneider (1972) arrived at several estimates of absolute age. He used relative age classes established by Lensink (1962). Although Schneider (1972) was able to show some strong correlations between absolute age of a captive and number of cementum layers, larger sample sizes are necessary.

Relative age criteria were established for the coastal California population based on characters of the skull, teeth, and postcranial elements (Morejohn, et al., 1975). For this population, age at sexual maturity has not yet been determined, but studies are underway.

## Migration Routes

The sea otter is not known to seasonally migrate from one part of its range to another and then return to its original area of distribution. The growing population off California is dynamic and range increases at the northern and southern ends of distribution are still in process as the animal gradually reinvades ancestral territory. This is not considered migration (Orr, 1970).

## Ecology

The sea otter is adapted to feeding largely on invertebrates along mainland shores or insular coasts in water usually less than 36 m (118.1 feet) (Kenyon, 1969; Miller, 1974); most feeding activity off California is in water of about 6 m (19.7 feet) in depth. In many parts of the sea otter's range, extensive foraging occurs within or in the vicinity of kelp forests; however, many otters also feed away from kelp beds over sandy bottoms.

## Economic Importance

The pelt of the sea otter is still considered to be one of the finest among fur bearing mammals. Each hair has associated with it a bundle of short underfur fibers numbering between 60 to 80 fibers, all emerging from a single follicle (Kenyon, 1969). The hair and underfur are very resilient and not brittle and the pelts have long wearing ability, as well as high insulating properties at low temperatures, because of air holding capability (Estes and Smith, 1973). Due to these excellent qualities, sea otter pelts become highly sought items. Kenyon (1969) stated that during the 170 years preceding the international moratorium imposed on fur trading nations, some one million pelts were harvested. At this time, an estimated 1,000 to 2,000 otters were all that remained throughout the entire former range of distribution.

## Abundance

From a former pre-fur trade abundance of between 100,000 to 150,000 animals, the sea otter, today, numbers in excess of 120,000 individuals in Alaskan waters (Alaska Department of Fish and Game, 1973). Miller (1974) considers conservatively that 1,700 is a close approximation of total population size, off California. Stabilization of this population has not yet occurred; rapid growth is still taking place.

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